**STATE OF UTAH**

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Governor

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# CENTERS OF EXCELLENCE

## ❖ ANNUAL REPORT

Fiscal Year July 1996 - June 1997
Published December 1997

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www.dced.state.ut.us/techdev/welcome.htm

State of Utah

Michael O. Leavitt, Governor

DEPARTMENT OF COMMUNITY AND ECONOMIC DEVELOPMENT
DIVISION OF BUSINESS AND ECONOMIC DEVELOPMENT

*David B. Winder, Executive Director*
*Richard J. Mayfield, Division Director*

**December 1997**

# To Recipients of the Utah Centers of Excellence Program Annual Report

Attached is the Annual Report for the Utah Centers of Excellence Program. The report summarizes the achievements of the program during the fiscal year *from July 1, 1996 through June 30, 1997* and in addition summarizes the funding allocations for the current 1997-98 fiscal year. The report has been formatted to provide special emphasis on centers related business activity and program enhancements.

## Report Format

Since the founding of the Centers of Excellence Program in 1986, the Annual Report has summarized the financial and business accomplishments in terms of dollars granted, matching funds received, jobs created in both centers and businesses, and other statistical data. This information provides appropriate measures of the status of the program, and is contained in this report in Appendices A and B. Every effort has been made to assure the accuracy of the statistical data, though it should be recognized that significant subjectivity is inherent in the summary of the numbers and in their interpretation. We have attempted to minimize the subjective interpretation of these statistics by supplementing them with anecdotal information which describes specific business activity related to the centers program, to provide more meaningful information relating to the overall impact which the program is having on Utah's economic vitality.

## Centers Related Business Activity

In addition to the statistical summaries, the report includes descriptions of new Utah companies. The companies share a common heritage in that each bases its revenue stream on technologies developed at funded Centers of Excellence and have licensed those technologies from Utah universities. Our intent is to review the Centers of Excellence Program from the standpoint of its influence upon a group of Utah's newest high tech companies. We hope to demonstrate that the funding of the program represents an incredibly valuable investment in Utah's current economic base and in the ongoing development of her high technology industries.

## Program Enhancements

In this report we have also highlighted the most current efforts being made to further enhance the effectiveness of the program. Three years ago the centers program instituted a commercialization consulting program designed to inject professional business research and management techniques into the process of launching new technologies into the business arena. It had been observed in previous years that many center directors did not have the time or often the expertise to initiate successful commercial ventures. The expectation of this initiative has been that by managing the process in a more professional way, the centers program would have opportunity to significantly enhance its impact on economic development. The consulting initiative is now beginning to mature and there have already been noteworthy accomplishments both in actual economic impact and in our understanding of the dynamics of the centers program.

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During the fiscal year reported, the centers program issued $2.39 million in grants to 21 active centers and one distinguished center for use in bringing significant new technologies closer to the marketplace. The matching funds received by these centers was $20 million, resulting in a matching fund ratio of 8.4 to one. The cumulative state funding for the centers program between 1986 and 1997 was $26.8 million and the cumulative matching funds received was $301 million, resulting in a matching fund ratio of 11.2 to one. This is believed to be the highest in the nation for programs of this kind and represents a critically important leverage for success in the program. Key statistical summaries are provided in Appendices A and B of this report.

The Centers of Excellence Program continues to be one of the nation's most successful technology commercialization programs as measured by matching dollars, significant new commercialized products, and state economic impact. We believe that with a continued and strengthened emphasis on the importance of commercialization and with the ongoing support of the new enhancements described, the Centers of Excellence Program will have an ever expanding and important role to play in Utah's economic future.

Respectfully submitted,

David B. Winder, Executive Director
Department of Community and Economic Development

Richard J. Mayfield, Director
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Roderick J. Linton, Director
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# Annual Report
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# I. Executive Summary

# Utah Centers of Excellence Program

## Fiscal Year 1996-97

**(July 1, 1996 - June 30, 1997)**

## EXECUTIVE SUMMARY

### Background of Program

The Utah State Legislature created the Centers of Excellence Program in 1986 recognizing that the growth of new industry and expansion of existing industry requires a strong technology base, new ideas, concepts, innovations, and prototypes. The Legislature recommended the allocation of economic development funds each year to the Centers of Excellence Program, to be awarded to college and university faculty on a competitive basis. The objectives of the Centers of Excellence Program are to enhance and expand the applied technical research activities at institutions of higher education in Utah, to develop technologies that are considered to have potential for economic development in the state, and to assist in the actual commercialization of those technologies. This research and technology commercialization process ultimately results in the creation of new companies, the enhancement of business opportunities for existing companies that license centers technologies, and in the growth of Utah's job opportunities. In addition, the proprietary value of technologies created is reflected in the number of patents issued and the associated royalty-bearing licenses which are signed.

These measurement parameters (jobs created, companies assisted and/or created, patents disclosed or issued, and license agreements signed) are summarized in the report to the legislature as indicators of the value of the centers program to state economic development. The report will also highlight some of the specific businesses which have either been spun-off from funded centers or been materially influenced by Centers of Excellence funding.

Ongoing funding of the program has been based upon the real and potential economic impact which the Centers of Excellence Program has had upon the State of Utah during the years since its creation. This Annual Report summarizes the significant accomplishments of the program during the recently completed fiscal year and attempts to identify the long term economic value of that work.

### Program Operations and Objectives

The operating methods of the centers program have evolved over the years since its inception with a continuing goal of achieving the maximum economic benefit from the individual centers that have been created.

Upon selection on a competitive basis, new centers are funded with a requirement for minimum 2:1 matching fund ratio from the private and federal sectors. Matching funds are reported and audited on a regular basis. Centers are also audited regularly for the achievement of technical and commercial milestones. Center directors are required to submit semiannual reports to the centers program director. The Centers of Excellence Program Annual Report, here attached, is based on submitted reports and upon information gathered in site visits, audits and other data sources. In addition, each funded center is assisted by one or more designated commercialization consultants who assist centers directors in defining commercialization strategies, performing market and competitive analysis, locating potential investors, etc.

Centers are normally expected to be self-sustaining through license contract royalties and new research grants at the end of five years and are then graduated. Centers with especially noteworthy histories and ongoing technological impact are designated as Distinguished Centers and thereafter may be funded on a

project by project basis as requests are approved. One distinguished center, the Center for Advanced Combustion Engineering and Research (ACERC) at Brigham Young University was funded in the 1996-97 period.

## Center Selection Process

Proposals from researchers for new and for renewal of existing Centers of Excellence are submitted to the centers office in response to a Request for Proposal which is normally sent in late December. The incoming proposals are submitted to the National Institute of Standards and Technology for scientific peer review and are thoroughly reviewed by the Centers of Excellence Advisory Council. Centers are selected for funding based on a ranking established in extended review sessions with the Centers Advisory Council.

Since its inception, and through FY 1996-97, the program has created 68 Centers of Excellence, seven of which have been designated as Distinguished Centers, 34 have graduated, and twenty-two are active during this reporting period.

The State Advisory Council for Science and Technology has advisory responsibility for the Centers of Excellence Program by statute. Members of the Science Council participate on the Centers Advisory Council in reviewing proposals and conducting site visits. This provides Science Council members with in-depth knowledge of the program, center specific information and a strong technical and industrial perspective for making funding decisions. The State Science Advisory reviews the Annual Report and presents it to the Science Council for acceptance. The Director of the Office of Technology Development serves as an ex-officio member of the State Advisory Council for Science and Technology.

## Commercialization Process

Over the past three years, the Centers of Excellence Program has funded a consulting program to assist Center Directors in preparing and implementing commercialization strategies. Each Center is unique in terms of which strategy is optimum - there is no single solution and each requires customized approaches.

Early market surveys and competitive analysis are conducted to discover which market segments are most promising and which product features will be of interest to potential customers and licensees. Consultants assist in targeting potential licensees for the technology and in positioning products for anticipated markets.

These early strategic discussions often reveal product variations that can be introduced to the marketplace earlier than previously planned. Such early commercialization has several benefits: (i) getting products to consumers for preliminary market validation and directional planning; (ii) early cash flow strengthens continuing research at the Center and hastens financial independence and; (iii) the future value of technology licenses are enhanced.

The Centers of Excellence office works closely with the Technology Transfer Offices at the respective universities in an effort to extract maximum value from the licenses that are signed for centers technologies. Through the commercialization consulting program assistance is given in defining market opportunities, identifying potential target licensees, providing key information for license valuations, and consulting assistance to those companies considering license opportunities.

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# II. Center Related Business Activity

This section introduces a selected group of new businesses recently incorporated and based on licensed technologies from funded Centers of Excellence. These young companies are representative of the types of high tech businesses which have developed from the centers program since its first funding in 1986. It is anticipated that as these companies mature they will have significant economic impact upon Utah's high technology business sector.

# Bionic Technologies, Inc.

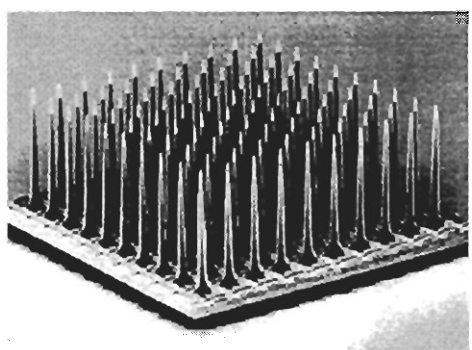
The Center for Neural Interfaces at the University of Utah was formed in 1995 to develop concepts and prototypes for neural prosthetics based on the research being done by Dr. Richard Normann and his team. This technology is based on miniature arrays of up to 100 electrodes that are inserted in the cortex of the brain. These electrodes enable external equipment to interface with those cortical neurons close to the electrode tips. The brain is a parallel processor but up until recently the neuroscientist has been limited to using only a few separate electrodes for their studies. The patented Utah electrode array allows the researcher to access neurons in 100 separate areas, providing a unique capability.

The long term mission of the center is to develop and integrate technologies that will provide the disabled with a range of prosthetic devices. For example, a blind person would wear a tiny TV camera mounted on a pair of glasses; this camera would be converted into signals that stimulate the electrodes and, thus, the nearby neurons, giving the person some visual acuity. A similar concept will be used to provide a deaf person with an auditory capability. In both these examples, the electrodes are being used to put signals into the brain. A different type of application would be with a quadriplegic. This person would have the array implanted into the motor cortex. He or she would have a repeatable, volitional thought (such as "Move my left foot"), and the electrodes and connected electronic equipment would detect the associated neuronal firing pattern. This firing pattern would then be used to control equipment such as a wheelchair or a computer solely by thought.

As is usual with the Centers of Excellence Program , the Center for Neural Interfaces was assisted by consultants in developing their commercialization strategy. The team realized that, although the marketing of human prosthetics is several years away, there was an immediate market in sales of the equipment developed at the center to other researchers. The decision was made to form a spin-off company to complete the productization of the technology and to take it to market.

**Bionic Technologies, Inc.**, was formed in mid-1996 and it licensed the technology from the University of Utah. The company has laboratory space in Research Park and has completed the development of the initial range of products in the following months: acute and chronic array assemblies, the array-inserter equipment, amplifiers and data acquisition software. It launched these products at the Society for Neuroscience Conference in November 1996, which was attended by over 25,000 persons. The response at its exhibitor booth from the international research community was enthusiastic and widespread. Since then, Bionic Technologies has continued manufacturing and marketing its products, with sales to Japan, Germany, Spain, Italy, The Netherlands, as well as to many leading universities in the U.S. It applied for - and was awarded - two Small Business Innovative Research grants (each has a Phase I for $110 k and a Phase II for $750 k) that has enabled it to pursue several novel product concepts in its own laboratories. It has since had booths at two other major conferences and these have only served to reinforce the interest in its products.

The Centers of Excellence Program has been pivotal in providing a bridge between this leading-edge technology developed at the University of Utah and a start-up Utah company. Without the Center for Neural Interfaces, there would not have been the focus on early commercialization nor a ready mechanism for spinning off a company. Technology transfer is a challenging process; it is not just a matter of issuing lists of available patents. It normally requires close collaboration between the technology developer and the licensee for a period of time, which is why it is more readily done with local companies. This has been a major factor in the success of Bionic Technologies in establishing the first stage in bringing this exciting technology to market.



Close-up view of the Abed-of-nails@neural probe developed by the Center for Neural Interfaces. These tiny probes, less than 1/4 inch on a side, can be implanted into brain tissue at selected locations to stimulate or monitor brain neural activity. Eventually the probes will provide artificial hearing and vision in human applications. A spin-off company, Bionics, Inc., is marketing the probes and associated electronic controls to researchers throughout the world.

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# Livestock Molecular Research and Development, Inc.

The Center for Genetic Improvement of Livestock at Utah State University recently identified a genetic marker for a trait in sheep called Spider Lamb Syndrome (SLS). Offspring that carry two copies of the mutated gene show severe bone deformities of the legs and the back. In contrast, animals that have one copy of the mutation look normal, but can produce offspring that have SLS.

The technology was licensed to **Livestock Molecular Research and Development, Inc.** which was incorporated in the state of Utah on June 26, 1997. The goal of the company is to conduct genetic marker tests in livestock species. Currently, the company offers genetic testing services for Spider Lamb Syndrome, a genetic disorder causing abnormal bone structures in sheep. The market demand for this test is significant and continues to rise, for example within the first four months of the existence of the company, more than 1300 samples were received for testing. The current international customer base includes Australia, Canada, U.K., and U.S.A. The company plans to expand the repertoire of tests to include parentage testing in cattle and sheep, and possibly the genetic tests for scrapie and callipyge.

**The DNA based test for SLS is 100% accurate in predicting carriers of the mutation and is the only test available in the world.**

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# PanGenics, Inc.

**PanGenics, Inc.** is a spin-off company largely as a result of the Utah Centers of Excellence Program and research developed at the Center for Developmental and Molecular Biology, Utah State University. PanGenic's mission is to identify and produce valuable plant, insect, animal or human proteins in the milk of genetically engineered animals that will allow the company to enter into new markets that were not previously possible. The mammary gland is at least a 10-fold more efficient bioreactor for the production of proteins as compared with conventional cell culture or fermentation processes.

The company is developing the production of four proteins, two of which are at the forefront. One protein is a flavor enhancer/sweetener protein. The other protein is anticipated to be an appetite suppresser. To minimize losses during the development period, the company is producing dairy products such as milk and cheeses.

In 1996, the Center of Developmental and Molecular Biology was showcased in the Utah Venture Capital Conference sponsored by the Wayne Brown Institute. This initiated the interest of investors in the science. An investor was identified from the conference that resulted in an infusion of capital and a technology license from Utah State University. The attraction of an investor, formation of the company, technology license from Utah State University, securing Small Business Innovation Research (SBIR) grants, and development of the science of transgenic production of proteins simply would not have happened without the support of the Centers of Excellence. Moreover, granting agencies to academic institutions support basic research and do not provide money for production of proteins in transgenic animals. So in addition to the business side of the company, the production of transgenic protein would not have occurred without center support. In this last year of center support, the remainder of the science is being developed at USU.

The company currently has five employees and owns a dairy operation to supply animals as needed for genetic engineering. Two Small Business Innovation Research (SBIR) grants have been awarded from the federal government to PanGenics. They are for the development of an appetite suppresser and to develop improved methods for making genetically engineered animals.

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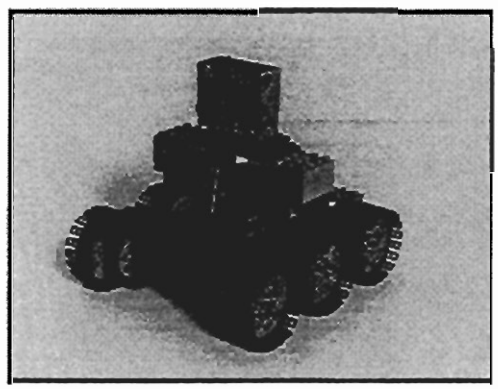
# Visionary Products, Inc.

The Center for Self-Organizing and Intelligent Systems at Utah State University was designated as a State of Utah Center of Excellence in June of 1992. The initial and continuing objective of the Center throughout the subsequent five years of its existence has been to help Utah industry develop marketable products using the technology broadly defined as that of self-organizing and intelligent systems. Initially the technological focus was on using two of the more popularly known intelligent technologies; artificial neural networks, and fuzzy logic inference machines. Both of these technologies found immediate use in research and development projects involving applications for planetary exploration programs for this nation's space program. One of these projects, undertaken at the encouragement of the national Aeronautics and Space Administration's Jet Propulsion Laboratory, was to develop a backup navigation scheme for forerunners of the small Sojourner rover vehicle, successfully used by NASA in last summer's landing and subsequent exploration of the planet Mars. The technology of fuzzy logic inference machines provided the core to the CSOIS solution to this challenging problem.

During this project, CSOIS had the opportunity to become closely associated with The Planetary Society (TPS), an international organization dedicated to advancing the cause of space and planetary exploration. At a meeting in the fall of 1994, the Executive Director of TPS, Dr. Louis Friedman, suggested that TPS and CSOIS enter into a joint project to develop a classroom educational product which would involve more of the nation's school children in the excitement of space exploration, and expose them at an early age to the advanced technical fields of computer control, intelligent systems, robotics, and so forth, which furnish the backbone of today's high-tech industries.

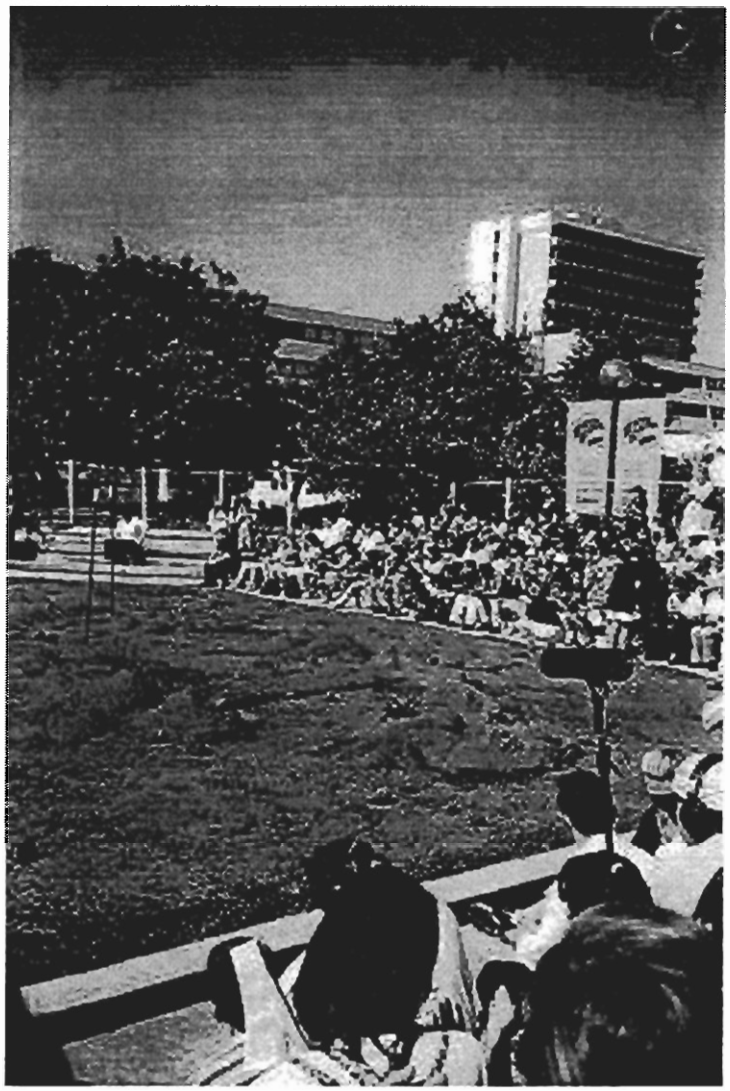
The project proposed by Dr. Friedman developed into the highly successful Red Rover, Red Rover Project, which is currently being produced and co-marketed by the Utah startup company **Visionary Products Inc.** (VPI), in partnership with the international educational and entertainment corporate giant, LEGO Corp. Because of the success of the classroom product, LEGO proposed in the Fall of 1996 that the same product development team of CSOIS, VPI, and LEGO develop a subsequent new product for the home education market. Licensing and royalty agreements for the CSOIS intellectual property rights to software and hardware have been negotiated and obtained through the efforts of the Utah State University Technology Transfer Office, assisted by the business consultants under contract to the Center of Excellence Program.



Visionary Products, Inc. is a turnkey product development company, turning ideas and concepts into consumer products using a better, faster, cheaper methodology. VPI develops both software and hardware products, and by utilizing the valuable resources of CSOIS, and using the Center as a technology engine, VPI is able to get an edge over larger developers in a similar field. In addition to the Red Rover software development discussed above, other products currently under development include a miniature camera that will be available to consumers in August 1998. VPI is also under contract to perform a feasibility study involving teleoperating a robotic vehicle on the surface of Mars in conjunction with the NASA Mars 2001 mission. Students in the Red Rover network would be actively involved in operating a robotic vehicle on Mars!

In conjunction with the mission of turning technological ideas into products, VPI is working toward its goal to become a successful for-profit Utah corporation. Within the next five years, its financial goal is to exceed an annual gross income of $5,000,000. Since its inception in April 1996, annual gross income jumped from $30,000 the first year, to more than $200,000 the following year. Next year's projected income is expected to exceed $500,000.

Millions of people around the world were glued to their television sets last summer as the Mars rover, Sojourner, began its highly publicized exploration of its new Martian neighborhood. Since this is exactly the purpose of the Red Rover educational product, the timeliness of commercialization couldn't have been better. Red Rover sales are already exceeding expectations, and inquiries have been pouring into TPS, CSOIS, VPI and LEGO. This publicity led to a full-page advertisement being featured in the Pitsco catalogue. Pitsco is the world's largest innovative educational product distributor, with an annual catalogue distribution of 300,000.



**The Red Rover project was featured at Planetfest '97, a 4-day discovery symposium produced by The Planetary Society and held in Pasadena, California over the weekend of July 4 during the landing of the Pathfinder Mission on Mars. Nearly 100,000 people attended this event, and Red Rover received an enormous response from children, their parents and educators. In addition, reports on Red Rover were seen on television news stations and in newspapers all weekend. This high degree of exposure continues, with Red Rover currently being featured at Comdex, the world's largest convention on computers and technology. Comdex is held this year in Las Vegas. The interest in Mars rovers and planetary exploration continues, and is expected to sustain an equally high level of sales for the new, much improved, home education version of Red Rover.**

Anyone who has traveled to Europe in the past year or two has to be aware of the intensive marketing of LEGO products. For example, LEGO kiosks are the first structures one encounters when first entering the busiest shopping malls of the British Isles and many of the other Common Market nations. LEGO now intends to extend its intensive campaigns to its already highly visible promotions in the United States and Canada. It is also well known that the internet provides perhaps the greatest opportunity in decades for development and marketing of new products, and the Red Rover product cashes in heavily on the connecting of members of the Red Rover community over the net. Couple these observations with the typical upscale and highly educated families likely to form the majority of Red Rover home education product customers, and the importance of Red Rover products in both national and international markets become rather self-evident.

Visit their web page at: http://planetary.org/rover-hq.html

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# Utah Centers of Excellence Program

## New Spin-off Companies

### FY1996-97

| Company Name | Center of Excellence |
|---|---|
| Applied Biosciences Corp.<br>St Moritz Terrace<br>Summit Park, UT<br>(801)647-9842 | Center for Bioremediation |
| PanGenics, Inc.<br>1770 No. Research Parkway, Suite 120<br>North Logan UT 84341<br>(435)753-6911 | Center for Developmental and Molecular Biology |
| Bonneville Technologies<br>P. O. Box 247<br>Sandy UT 84091 | Center for Electronic Systems Technology |
| Livestock Molecular Research and Development, Inc.<br>Logan, Utah<br>(435)797-3903 | Center for Genetic Improvement of Livestock |
| Radiant Labs<br>Salt Lake City, UT<br>(801)582-9923 | Center for MTV Flat Panel Display |
| Bionic Technologies Inc.<br>1763 East 900 South<br>Salt Lake City, UT<br>(801)582-9909 | Center for Neural Interfaces |
| Visionary Products<br>275 N. State<br>Richmond, Utah<br>(818)457-1969 | Center for Self Organizing Intelligent Systems |

# III. Funded Centers

The following section is a listing of all the centers funded during the 1996-97 fiscal year, including highlights of activities during the year and a summary of financial and economic impact information.

# Center for Advanced Combustion Engineering Research

Director: L. Douglas Smoot, Ph.D., Brigham Young University, Provo, Utah
Phone 378-2804, Fax 378-3831

**The center focuses on the application of combustion technology to produce high-quality energy from fossil fuels and to reduce pollution from waste incineration.**

## Background

Established in 1986 as a joint collaboration between Brigham Young University and the University of Utah for the purpose of advancing combustion engineering research, education, and technology. The principle focus is on clean and efficient use of fossil fuels including coal, oil, and natural gas as well as the combustion of toxic and municipal solid wastes. The center research program consists of 35 active research projects among 62 participants focused on 6 thrust areas.

*Received "Distinguished Center" status in 1991*

## Technology Development Progress

The nation's basic and high-technology industries rely upon the adequate supply of high-quality energy, the production of which depends upon combustion technology. The international competitiveness of these industries depends in part on their ability to more efficiently use low-cost fuel resources such as coal, heavy oil, oil shale, and tar sands, which are abundantly available in the western United States and particularly in Utah. Specific center technologies include:

- Mechanisms of fossil-fuel combustion and pollutant and soot formation.
- The relationship between fuel properties and conversion.
- Computer models to control and record the performance of particular combustion chambers.
- Pollution formation/control and waste incineration.

## Highlights and Accomplishments

The center has attracted over **$80 million** in matching funds over eleven years. A highly significant number (60) of license agreements have been signed. The center provides consulting and technical services to Utah companies. The center has provided new technology for Utah companies such as REI, Inc., and Geneva Steel Company. New technology and software products from the center have led to the creation of **six new businesses in Utah.** The center is one of 18 highly sought-after national engineering centers.

This center is an excellent example of state funding leverage. The NSF funding was contingent upon state funding support.


## Summary Data:

| Current | | Cumulative | |
|---|---|---|---|
| 1996-97 Award | $100,000 | Awards | $1,100,000 |
| Matching Funds | $4,128,999 | Matching Funds | $75,218,402 |
| Patents Pending | 0 | Patents Issued | 2 |
| Patents Issued | 0 | License Agreements | 60 |
| License Agreements | 0 | Spin-off Companies | 6 |
| Spin-off Companies | 0 | | |
| Companies Assisted | 172 | | |
| Industry Jobs | 46 | | |
| Center Jobs | 138 | | |

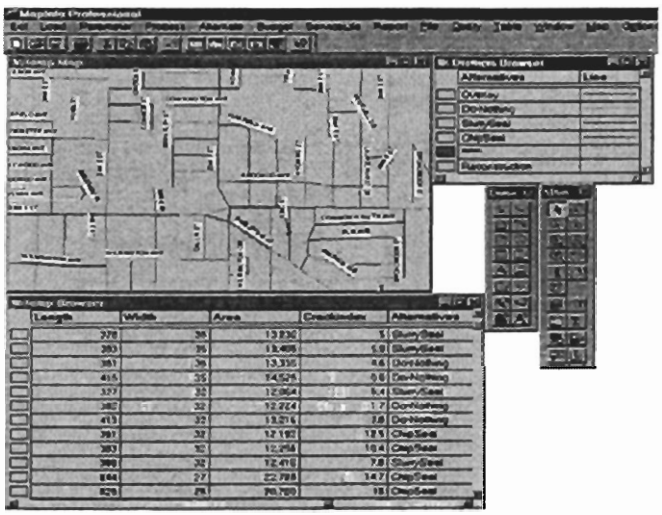
# Center for Advanced Construction Materials

Director: Hosin Lee, Ph.D., University of Utah, Salt Lake City, Utah
Phone 585-3512, Fax 585-5477, e-mail: hlee@civil.utah.edu

**The center's major emphasis is in the development of new and recycled construction materials, and innovative techniques for inspecting the condition of constructed facilities.**

## Background

Established in 1993 the center's major emphasis is in the development of new and recycled construction materials, and innovative techniques for inspecting the condition of constructed facilities.



## Technology Development Progress

Core technologies include: (1) automated facilities management system (AFMS), e.g. to measure and analyze pavement cracks to schedule maintenance strategies; (2) tire added latex concrete blocks, to use waste materials and to improve performance (3) new construction product testing and evaluation services.

## Highlights and Accomplishments

Two modules have been developed in the AFMS: PicCrack and MapCrack. PicCrack takes digitized pictures of pavement cracks and computes a crack index using a proprietary image processing algorithm at significant lower costs that currently available manual systems. MapCrack selects the most appropriate maintenance strategy and provides present costs and long-term budget estimates for maintenance programs.

The AFMS has been beta-tested in four cities in Utah and the results were favorable. The software is being copyrighted and licensees are being sought.

## Summary Data:

**Current**

| | |
|---|---|
| 1996-97 Award | $75,000 |
| Matching Funds | $181,653 |
| Patents Pending | 2 |
| Patents Issued | 0 |
| License Agreements | 0 |
| Spin-off Companies | 0 |
| Companies Assisted | 31 |
| Industry Jobs | 9 |
| Center Jobs | 7 |

**Cumulative**

| | |
|---|---|
| Awards | $175,000 |
| Matching Funds | $473,916 |
| Patents Issued | 0 |
| License Agreements | 0 |
| Spin-off Companies | 2 |

# Application Center for Materials Engineering

Director: Paul Eastman, Ph.D., Brigham Young University, Provo, Utah
Phone 378-7878, 378-2759, Fax 378-7575, e-mail: acmecenter@byu.edu

**The center provides engineering services to industrial clients in materials design and selection.**

## Background

ACME is an important resource in Utah for technical knowledge and capability in the areas of plastics, composite materials and recently, metallurgy. ACME assists existing and start-up companies and also conceives, invents, develops, and spins off into commercial enterprises new or enhanced products.

## Technology Development Progress

The center has patented the following technologies: (1) cure and contamination sensing devices, which allow for low cost detection of the physical or chemical changes in non-conducting fluids, e.g. resins, oils transformer fluids etc.; (2) damping of composites through unique orientation of fibers; (3) improvement of fiber binding on thermoplastic composites; (4) forming technique for large thermoplastic composites.

## Highlights and Accomplishments

Since its inception in 1990, the center has assisted 164 companies, and provided services to launch a total of 50 companies. ACME continues to provide services to Utah's small businesses and manufacturing firms by coordinating a network of experts in the areas of advanced materials, using resources at the University of Utah, Brigham Young University and the Utah Manufacturing Extension Partnership. The center has graduated.

ACME
APPLICATION CENTER FOR MATERIALS ENGINEERING

## Summary Data:

| Current | | Cumulative | |
|---|---|---|---|
| 1996-97 Award | $125,000 | Awards | $865,000 |
| Matching Funds | $867,000 | Matching Funds | $6,348,728 |
| Patents Pending | 1 | Patents Issued | 4 |
| Patents Issued | 4 | License Agreements | 4 |
| License Agreements | 4 | Spin-off Companies | 46 |
| Spin-off Companies | 0 | | |
| Companies Assisted | 164 | | |
| Industry Jobs | 0 | | |
| Center Jobs | 29 | | |

Services were provided to new companies being launched

# Center for Applied Molecular Genetics Selection

Director: Robert L. Park, Ph.D., Brigham Young University, Provo, Utah
Phone 378-6871, Fax 378-4211, email: robert_park@byu.edu

**The center investigates genetic markers associated with desirable traits in swine and cattle and proposes to market animal screening capabilities.**

## Background

Established in 1995, the main focus of the center is to identify specific DNA probes related to economically important qualitative and quantitative genetic traits in domesticated animals, e.g., cattle and pigs. DNA markers for traits such as back-fat thickness, feed conversion efficiency, and growth rate are of interest for swine, whereas in dairy cattle markers for annual milk and protein yield traits are being researched.

## Technology Development Progress

Useful DNA based probes are being developed and screened. The technologies including random amplified polymorphic DNA (RAPD), restriction fragment length polymorphisms (RFLP) and sequence characterized amplified regions (SCAR). The objective is to identify probes that correlate with useful qualitative and or quantitative traits.

Swine markers showing correlations with specific traits are: back-fat (9), feed intake (4), and growth rate (11). During the current year, further testing has revealed that four back fat markers, two feed intake markers and six growth rate markers will be useful.

The search for DNA markers in dairy cattle to correlate with milk and protein yield, has resulted in the identification of 3 useful markers.

## Highlights and Accomplishments

The economic value of the DNA markers and the methods for detecting them lies in the ability to identify desirable breeding animals before they mature and produce offspring thus reducing breeding costs significantly. Contacts with key swine and cattle breeding companies are being pursued and there are early indications of significant interest when the technology has been validated.

Commercialization opportunities in other areas are also under investigation. For example, in the ostrich industry, genetic markers to predict egg production, fertility and hatchability, would be of interest. Another application is determining the gender of the ostrich birds, as it is difficult to identify female birds for up to 12 months. Five DNA markers that correlate with the female chromosome have been identified.

**Sonata - from the dairy breeding stock**

## Summary Data:

| Current | | Cumulative | |
|---|---|---|---|
| 1996-97 Award | $115,000 | Awards | $215,000 |
| Matching Funds | $409,250 | Matching Funds | $1,028,740 |
| Patents Pending | 0 | Patents Issued | 0 |
| Patents Issued | 0 | License Agreements | 0 |
| License Agreements | 0 | Spin-off Companies | 0 |
| Spin-off Companies | 0 | | |
| Companies Assisted | 6 | | |
| Industry Jobs | 0 | | |
| Center Jobs | 17 | | |

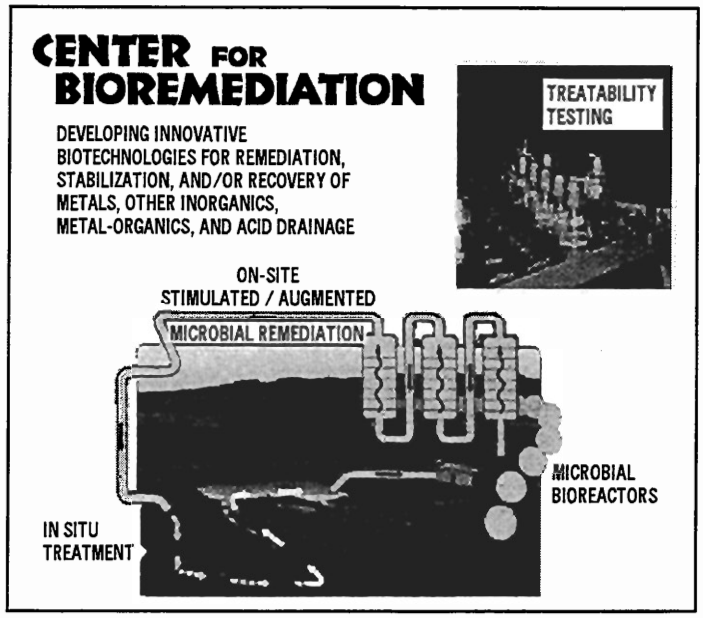
# Center for Bioremediation

Director: D. Jack Adams, Ph.D., Weber State University, Ogden, Utah
Phone 626-6058, Fax 626-7467, email: djadams@weber.edu

**Bioremediation is the use of biology and technology to clean up environmental pollutants and reclaim soil and water systems.**

## Background

Established in 1996, to facilitate development, enhancement, and marketing of technologies based on microorganisms, biological materials, and enzyme components for bioremediation and environmental restoration applications. Bioremediation uses reclamation and biotechnology including microbiology. Microorganisms can be thought of as chemical factories, which in the process of growing and reproducing, metabolize and transform organics and inorganics (arsenic, nitrates, etc.) for energy and respiration. In this process metals can be transformed to more stable, less soluble, and/or less toxic states. The Center for Bioremediation develops, implements, and markets innovative biotechnologies to solve one of the most complex and widespread remediation problems - metals contamination.




## Technology Development Progress

The center focus is on the commercialization of various aspects of microbial bioremediation technologies including, selenium removal/recovery, arsenic removal/recovery and cyanide destruction. A mobile plant for lead remediation at firing ranges is developed. The center is pursuing partnerships and collaborations with industry, federal agencies and universities in various areas of bioremediation.

## Highlights and Accomplishments

A center bioprocess was successfully used, on a commercial scale, to meet discharge criteria for cyanide, selenium, nitrate, and other metals at a Nevada mining operation. A mobile soil treatment plant was successfully demonstrated at Miramar, NAS in California, to clean-up lead from firing range soils

A new company, Applied Biosciences Corp., has been created to collaborate with the center and attract SBIR and STTR funding.

## Summary Data:

**Current**

| | |
|---|---|
| 1996-97 Award | $90,000 |
| Matching Funds | $1,664,200 |
| Patents Pending | 0 |
| Patents Issued | 0 |
| License Agreements | 0 |
| Spin-off Companies | 0 |
| Companies Assisted | 29 |
| Industry Jobs | 2 |
| Center Jobs | 10 |

**Cumulative**

| | |
|---|---|
| Awards | $90,000 |
| Matching Funds | $1,664,200 |
| Patents Issued | 0 |
| License Agreements | 0 |
| Spin-off Companies | 1 |

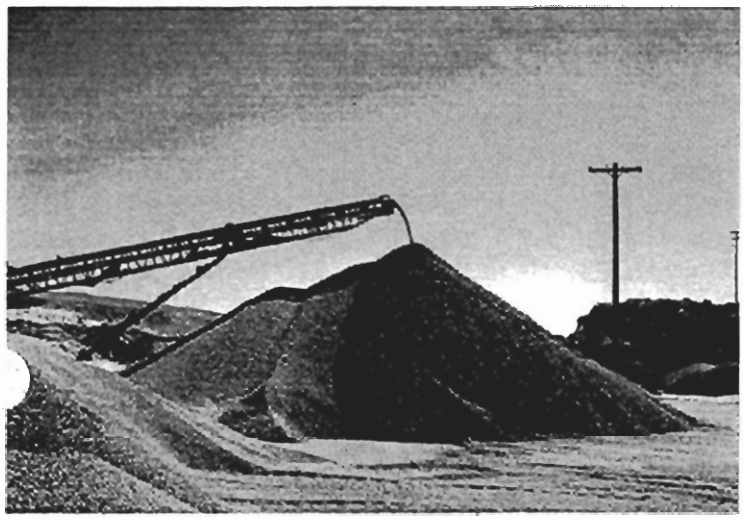
# Center for Coal Processing Technology

Director: J. D. Miller, Ph.D., University of Utah, Salt Lake City, Utah
Phone 581-5160, Fax 581-8119, email:jdmiller@mines.utah.edu

**The center promotes the development of a coal resin industry in central Utah and provides an advanced processing technology base for the nation's coal industry.**

## Background

This Center was established in 1996, to provide an advanced processing technology base for the nation's coal industry, and to promote the development of a coal resin industry in Central Utah.



## Technology Development Progress

The technology development effort is concentrated in the following areas: processing technology for the recovery and refining of coal resin, x-ray CT technology for coal washability analysis and fine coal cleaning by air-sparged hydrocylone flotation.

## Highlights and Accomplishments

Contacts with key companies have been made to evaluate the development of a coal resin industry in Central Utah. Coal samples from three mining companies were analyzed for resin content. Discussions were initiated with a Utah company to recover resin from stockpiled coal rejects.

## Summary Data:

**Current**

| | |
|---|---|
| 1996-97 Award | $100,000 |
| Matching Funds | $318,333 |
| Patents Pending | 0 |
| Patents Issued | 0 |
| License Agreements | 0 |
| Spin-off Companies | 0 |
| Companies Assisted | 10 |
| Industry Jobs | 0 |
| Center Jobs | 12 |

**Cumulative**

| | |
|---|---|
| Awards | $100,000 |
| Matching Funds | $318,333 |
| Patents Issued | 0 |
| License Agreements | 0 |
| Spin-off Companies | 0 |

# Center for Developmental and Molecular Biology

Directors: Kenneth White, Ph.D. & John Morrey, Ph.D. Utah State University, Logan, Utah
Phone 797-2149, Fax 797-2118, e-mail: kwhite@cc.usu.edu

**The center investigates specific protein molecules that may have therapeutic value and the production of these proteins in the mammary glands of genetically engineered animals.**

## Background

Established in 1993, one of the Center objectives has been to investigate, characterize and synthesize several chemotherapeutic proteins (lytic peptides)and to develop cost-effective production methods. One of these methods involves the production of the proteins using genetically engineered animals (transgenic animals) that can secrete the proteins at high concentrations in their milk.

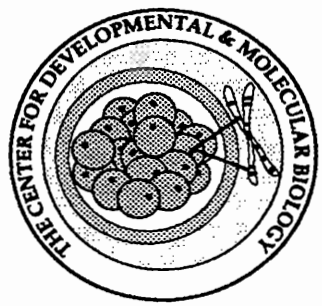
## Technology Development Progress

Technologies are being developed for the high efficiency production of valuable proteins (e.g. lytic peptides), not normally found in animal milk, by producing transgenic animals. Genes (DNA sequences) that code for the specific peptides of interest are introduced into the embryos of selected animal species which, when successful, express the desired protein in the milk producing cells or glands. The expression of the foreign protein in the milk in relatively high quantities provides a cost-effective method of producing the valuable proteins.

## Highlights and Accomplishments

Genes for specific peptides have been sequenced and prepared for injection into animal embryos. These genes have been successfully injected in mouse embryos and the transgenic nature of the new-born animals have been confirmed.

Similar methods have been used to produce goats which, it is expected, will express the desired proteins in their milk. Expression of the proteins in transgenic goats is highly desirable because the animals produce significant quantities of milk and are relatively easy to breed and maintain.




**Three different types of transgenic mice, each carrying a single lytic peptide gene or one of two plant protein genes, have been produced and the presence of the putative gene confirmed. In addition, a transgenic goat has also been produced.**

**A new spin-off company PanGenics, Inc. has been established in Utah. The company has received a Phase I SBIR award from NIH for $80,000.**

## Summary Data:

| Current | | Cumulative | |
|---|---|---|---|
| 1996-97 Award | $150,000 | Awards | $510,880 |
| Matching Funds | $601,159 | Matching Funds | $1,405,642 |
| Patents Pending | 2 | Patents Issued | 1 |
| Patents Issued | 1 | License Agreements | 1 |
| License Agreements | 1 | Spin-off Companies | 1 |
| Spin-off Companies | 1 | | |
| Companies Assisted | 10 | | |
| Industry Jobs | 4 | | |
| Center Jobs | 13 | | |

# Center for Electronic Systems Technology

Directors: R. Jennifer Hwu, Ph.D. & Benjamin V. Cox, Ph.D., University of Utah, Salt Lake City, Utah
Phone 581-6954, Fax 581-5281, email hwu@ee.utah.edu

**The Center provides research, design, evaluation, & prototyping services to Utah business who need specialized help in developing new products or enhancing market strengths**

**Background**

Established in 1995, this center combines the expertise, resources, and capability of three universities: the UofU, BYU and USU to serve the industrial community in the area of electronic systems technology. The goal of the Center is to ensure that Utah industry can compete more effectively in the global market and enhance the opportunities for Utah researchers to develop and commercialize their technologies.

**Technology Development Progress**

Electronic systems technologies include microelectronics, signal processing, communication and control systems, digital electronics, RF, microwave, and millimeter wave electronics, optoelectronics and electromagnetics. The Center provides research, design, evaluation, and prototyping services to Utah business who need specialized help in developing new products or enhancing market strengths.

**Highlights and Accomplishments**

Services that are being provided to industry include access to test equipment, laboratory testing, fundamental research and technology development, market analysis, personnel, information, and strategic planning. Research contracts with a large number of technology based companies have been signed and are in progress. Institutions that have collaborated with the Center include: TRW, Lockheed Martin, U.S. Robotics, Loral Communications, Keithley, Micron Technologies, Sandia National Laboratories, Micromanipulator, American Laser, Litton, Unisys, Digital Instruments, Alliantech Systems, National Semiconductor, and Fairchild

Dr. Jennifer Hwu received the prestigious U.S. Presidential Early Career Award for Scientists and Engineers for her contributions and leadership in high power frequency electronics and optoelectronics. She was also named a U.S. Presidential Faculty Fellow.

CEST THE STATE OF UTAH CENTER OF EXCELLENCE FOR ELECTRONIC SYSTEMS TECHNOLOGY

## Summary:

**Current**

| | |
|---|---|
| 1996-97 Award | $150,000 |
| Matching Funds | $448,575 |
| Patents Pending | 2 |
| Patents Issued | 1 |
| License Agreements | 1 |
| Spin-off Companies | 0 |
| Companies Assisted | 27 |
| Industry Jobs | 3 |
| Center Jobs | 29 |

**Cumulative**

| | |
|---|---|
| Awards | $310,000 |
| Matching Funds | $1,561,675 |
| Patents Issued | 1 |
| License Agreements | 1 |
| Spin-off Companies | 2 |

# Center for Genetic Improvement of Livestock

Director: Noelle Cockett, Ph.D., Utah State University, Logan, Utah
Phone 797-3903, Fax 797-3904, e-mail: fanoelle@cc.usu.edu

**The center has identified genetic markers associated with desirable and undesirable traits in sheep, and markets a testing service to screen animals.**

## Background

The center was established in 1991 to identify genetic markers for economically important traits of livestock. The first trait for which genetic markers were identified, was for callipyge gene in sheep, responsible for heavy muscling. Sheep carrying the callipyge gene have 8% more muscle, 8% less fat and 2% less bone, when compared to sheep that do not express the gene. The center has recently identified a genetic marker for a second trait in sheep called Spider Lamb Syndrome (SLS), which results in severe bone deformities of the legs and back in animals with two copies of the mutation. Animals that have one copy of the mutation look normal but can produce spider off-spring.

## Technology Development Progress

The center has determined that the callipyge gene provides an **additional $16.06 (10.3%)** to the value of each marketed sheep. If just 25% of the sheep in Utah carried the callipyge gene, the potential added value impact to Utah would be $1.4 million. The center has control of the genetic testing procedure necessary for identification of animals carrying the callipyge gene and Spider Lamb Syndrome. The center has developed a test that is 97% accurate in identifying the callipyge gene and a test that is 100% accurate in identifying carriers of the SLS defect. No other laboratory in the world has the available information and, therefore cannot duplicate these tests.

## Highlights and Accomplishments

The center provides a genetic screening service for breeding programs. To date over 600 animals have been evaluated for the presence of callipyge gene from commercial flocks in the U.S., resulting in revenues to the center. Over 1400 tests have been performed for SLS resulting in revenues of over $35,000 to date. A patent application has been filed on the SLS test.

A new company, has been formed to perform the genetic testing, **Livestock Molecular Research and Development Inc.,** with laboratories in Logan, Utah, and Monticello, Illinois.

The first and third sheep, from left, have developed big butts because of a mutant gene inherited only from the male, researchers at USU have discovered.

## Summary Data:

**Current**

| | |
|---|---|
| 1996-97 Award | $40,000 |
| Matching Funds | $132,000 |
| Patents Pending | 1 |
| Patents Issued | 0 |
| License Agreements | 1 |
| Spin-off Companies | 1 |
| Companies Assisted | 8 |
| Industry Jobs | 2 |
| Center Jobs | 5 |

**Cumulative**

| | |
|---|---|
| Awards | $336,500 |
| Matching Funds | $698,985 |
| Patents Issued | 0 |
| License Agreements | 1 |
| Spin-off Companies | 1 |

# Center for Genome Technologies

Director: Robert Weiss, Ph.D., University of Utah, Salt Lake City , Utah
Phone 585-7764, Fax 585-7177, email: bobweiss@genetics.utah.edu

**The center, a part of the international human genome project, develops methods for rapid, large scale genome sequencing, and proposes commercial uses for this analysis.**

## Background

Established as a Utah Center of Excellence in 1996, the center's main focus is on developing and refining technologies for large scale sequencing and genotyping of DNA, the genetic material involved in inheritance of every organism.

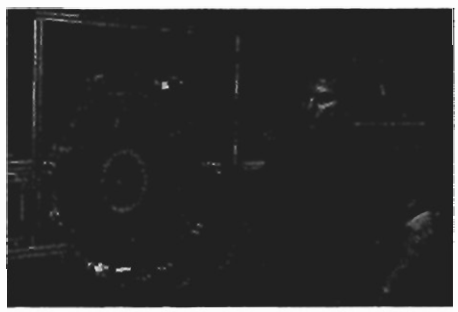
## Technology Development Progress

The center is developing novel technologies in three different areas: molecular reagents and techniques, automated sequencing devices, and computer software. Refinements to improve performance and reliability of the automated hybridization and imaging instruments are in progress. Independent testing of the instruments by non-center researchers is in progress.

**The center has licensed two software programs to a local company, Cimarron Software Inc.**

## Highlights and Accomplishments

Researchers at the University of Utah Human Genome Center have international recognition in being part of the Human Genome Project, funded by the U.S. Department of Energy and the U.S. National Institutes of Health. The research group has been involved in a worldwide effort in sequencing the Human Genome. In addition, the center continues to be at the leading edge of technology development for automated DNA sequencing. The center will release the complete genome sequence of a microorganism of significant scientific and biotechnological importance. This sequence publication is among the first ten genomes completed world-wide and is an important milestone, showcasing the maturation of the center technology.



Picture of the probe chamber, an instrument for multiplex sequencing designed and built at the Genome Center.

## Summary Data:

| Current | | Cumulative | |
|---|---|---|---|
| 1996-97 Award | $175,000 | Awards | $175,000 |
| Matching Funds | $5,516,257 | Matching Funds | $5,516,257 |
| Patents Pending | 0 | Patents Issued | 0 |
| Patents Issued | 0 | License Agreements | 2 |
| License Agreements | 2 | Spin-off Companies | 0 |
| Spin-off Companies | 0 | | |
| Companies Assisted | 1 | | |
| Industry Jobs | 0 | | |
| Center Jobs | 46 | | |

# Center for Industrial Imaging

Director: Robert Ehrlich, Ph.D., University of Utah, Salt Lake City, Utah
Phone 581-5906, Fax 585-3540

**The center has developed sophisticated software to process digital images and do complex data analysis. Commercial applications include both geoscience and medical products.**

## Background

This center was established in 1995 to identify markets and commercialize technologies in proven geoscience applications and other areas, e.g. ceramics, metallurgy, and medical imaging.

## Technology Development Progress

The core technology of the Center is *Petrographic Image Analysis* (PIA), which comprises four components: image acquisition, image processing, pattern recognition/data analysis and links to physical models. Each component requires specialized hardware, software and expertise. The pattern recognition procedure within PIA has proven useful in chemical fingerprinting in a variety of geoscience/environmental applications. The center has begun to explore areas outside geoscience that have a larger economic potential, namely the medical imaging arena.

The center has been granted ownership of *Integrated Paleontological System* (IPS) Software, for further research, development and commercialization. IPS is a UNIX and PC based application for analysis and integration of geologic data in petroleum exploration and production, initially developed by the Unocal Corporation.

## Highlights and Accomplishments

*Environmental & Geoscience applications*: The center completed a demonstration project incorporating PIA into a multi-disciplinary basin study in Azerbaijan, Former Soviet Union. The project was sponsored by a consortium of petroleum companies and provided over $600,000 in matching funds. A new petroleum related PIA demonstration project in Turkmenistan, Former Soviet Union, began just prior to end of fiscal year 1996-1997.

*Medical Applications*: Two phases of a pilot study were completed to evaluate the feasibility of applying center technologies to medical imaging, specifically in the area of prostate cancer pathology. The effort is now directed towards cataloguing images, which will be used to calibrate the automated classification routines.

*Technical Alliance for Computational Stratigraphy (TACS)*: Eight major oil companies, including Unocal, Phillips, NorskHydro, British Gas, Pennzoil, Chevron, Shell & Exxon, have made a commitment to spent $185,000/year for 3 years to develop the TACS software.

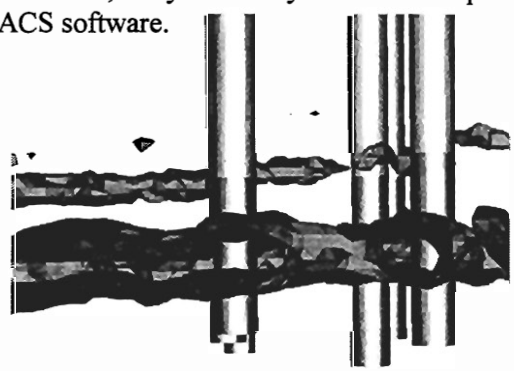


Image from isosurfacing of 3-D seismic data showing location of producing natural-gas reservoir sands, onshore Gulf Coast. Well locations are as superimposed cylinders. Image prepared as part of joint project with the Center for Scientific Computing & Imaging, U/U.

## Summary Data:

**Current**

| | |
|---|---|
| 1996-97 Award | $100,000 |
| Matching Funds | $354,853 |
| Patents Pending | 0 |
| Patents Issued | 0 |
| License Agreements | 0 |
| Spin-off Companies | 0 |
| Companies Assisted | 27 |
| Industry Jobs | 0 |
| Center Jobs | 4 |

**Cumulative**

| | |
|---|---|
| Awards | $200,000 |
| Matching Funds | $ 760,693 |
| Patents Issued | 0 |
| License Agreements | 0 |
| Spin-off Companies | 0 |

# Center for Intelligent Computer Tools

Director: William Barrett, Ph.D., Brigham Young University, Provo, Utah
Phone 378-7430, Fax 378-7775, email: barrett@cs.byu.edu

**The center develops intelligent computer tools for the creation, manipulation, and presentation of digital images.**

## Background

Established in 1996, this center is focused on the creation of intelligent computer tools including: interactive image segmentation and composition, automated creation of digital libraries, and semi-automated creation of virtual environments from real world images.

## Technology Development Progress

The technology development effort is concentrated in the following areas: **intelligent scissors/paint,** which performs image segmentation and composition; **color quantization**, which represents full color images with limited palette and no visual loss; **query by image content,** which looks for all images that are similar; **document recognition**, to recognize and output raw paper documents for posting papers on the web; **family history creation**, an automated system to search for and assemble personal histories; and **virtual environments**, to create a realistic virtual environment from real world images.

## Highlights and Accomplishments

The intelligent scissors/paint technology has been used to build: a montage of framework for movies, projective snapping and block matching, and for hierarchical collection of intelligent paint. A **digital ancestral library** was built using search engines to automatically match names with databases containing historical vignettes and photographs, to create personal histories of Utah Pioneers. This program was demonstrated at the Sesquicentennial celebration.
Progress in the commercialization effort included the demonstration of the value added benefit of integrated technology to three Utah companies, which are now collaborating with the Center. Two technologies were **licensed** to a major company in California.

State Legislature - Timpanogos Session

This image (with the state capitol nestled in the mountains) was completely computer-generated. A major focus of the center is the creation of photorealistic virtual environments, such as this, that would depict and allow interaction with future Olympic sites.

## Summary Data:

| Current | |
|---|---|
| 1996-97 Award | $100,000 |
| Matching Funds | $533,430 |
| Patents Pending | 0 |
| Patents Issued | 0 |
| License Agreements | 2 |
| Spin-off Companies | 0 |
| Companies Assisted | 4 |
| Industry Jobs | 0 |
| Center Jobs | 15 |

| Cumulative | |
|---|---|
| Awards | $100,000 |
| Matching Funds | $533,430 |
| Patents Issued | 0 |
| License Agreements | 2 |
| Spin-off Companies | 0 |

# Center for Minerals Technology

Director: R. Peter King, Ph.D., University of Utah, Salt Lake City, Utah
Phone 585-3113, Fax 581-8119, e-mail: rpking@mines.utah.edu

**The Center's focus is on developing new technologies for the minerals processing industry.**

**Background**

Established in 1995 the Center's focus is on developing new technologies for minerals processing. Specific areas of expertise include the design of high efficiency grinding mills using state of the art computer simulation software, advanced mill analysis and monitoring methods, technologies for the in-line monitoring and measurement of particle size on moving conveyor belts, and the real-time control of industrial milling processes.

**Technology Development Progress**

Computer software, on-line instruments and laboratory procedures for the design, monitoring control and analysis of industrial grinding machines and operating plants have been demonstrated and are being designed for industrial applications.

**Highlights and Accomplishments**

An instrument to measure the distribution of sizes of particles on moving conveyor belts has been developed and successfully tested at industrial sites. This instrument is of great value because it eliminates the need to take samples from the conveyor for remote analysis and therefore provides real-time process control for mining and milling operations.

A laboratory on-line particle analysis system (OPSA) was installed at an industrial site for plant control by pellet characterization. **Five companies have expressed an interest in licensing the OPSA technology.**

The Center continues to concentrate on demonstrating the application of new technologies in an industrial setting.

Center for Minerals Technology

## Summary Data:

**Current**

| | |
|---|---|
| 1996-97 Award | $115,000 |
| Matching Funds | $341,414 |
| Patents Pending | 0 |
| Patents Issued | 0 |
| License Agreements | 1 |
| Spin-off Companies | 0 |
| Companies Assisted | 2 |
| Industry Jobs | 0 |
| Center Jobs | 4 |

**Cumulative**

| | |
|---|---|
| Awards | $240,000 |
| Matching Funds | $1,011,892 |
| Patents Issued | 0 |
| License Agreements | 1 |
| Spin-off Companies | 0 |

# Center for MTV Flat Panel Display Technology

Director: Laurence P. Sadwick, Ph.D., University of Utah, Salt Lake City, Utah
Phone 581-8282, Fax 581-5281, email: sadwick@ee.utah.edu

**The center is developing innovative technologies for the production of flat panel displays.**

## Background

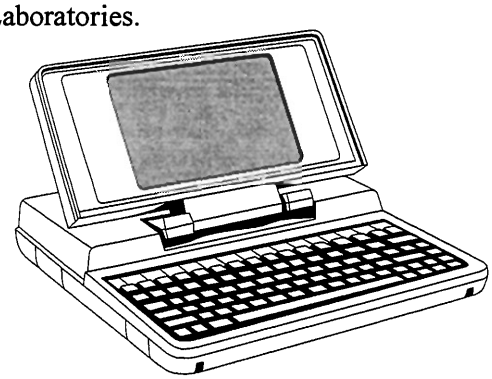
Established in 1995 to study new technologies to in producing flat panel displays for the information (e.g., computer monitors) and entertainment (e.g., television sets) markets. The main focus is to conduct proof-of-principle research on new and emerging potential flat panel display technologies and to evaluate new and existing flat panel display technologies. An additional focus is to create and support applications needed by flat panel display manufacturers especially those located in the State of Utah.

## Technology Development Progress

The technology and services provided by the center are in the following areas: (i) prototype development and testing of novel flat panel display technologies; (ii) development of high temperature electronics based on MTV electronics technology; (iii) develop tools to test and evaluate flat panel display technologies; (iv) work with industry (especially those located in Utah) in addressing and supporting their flat panel display technology needs; and (v) develop new and novel flat panel display core technologies.

## Highlights and Accomplishments

Developed a new, enhanced flat panel display for which a patent application has been submitted. Established a close working relationship with a local company involved in flat panel display development. A new company has been established with an option to license the flat panel display technology. Received Department of Energy funding to investigate another spin-off technology for micro-energy converters under a collaborative development effort with Sandia National Laboratories.



A primary application for MTV flat panels would be laptop displays

## Summary Data:

| Current | | Cumulative | |
|---|---|---|---|
| 1996-97 Award | $125,000 | Awards | $190,000 |
| Matching Funds | $303,000 | Matching Funds | $ 722,655 |
| Patents Pending | 2 | Patents Issued | 1 |
| Patents Issued | 1 | License Agreements | 1 |
| License Agreements | 1 | Spin-off Companies | 1 |
| Spin-off Companies | 1 | | |
| Companies Assisted | 10 | | |
| Industry Jobs | 15 | | |
| Center Jobs Created | 16 | | |

# Center for Multimedia Education and Technology

Directors: Magdy F. Iskander, Ph.D. & Richard W. Grow, Ph.D., University of Utah, Salt Lake City, Utah
Phone 581-6944, Fax 581-5281, e-mail: iskander@ee.utah.edu

**The center's main goal is the development of interactive multimedia software modules for education.**

**Background**

Established in 1993 for the development of interactive multimedia software modules for science, mathematics, and engineering education.

**Technology Development Progress**

Software and hardware interactive multimedia products for education including simulation software, virtual laboratories, software and hardware for data acquisition and analysis, inexpensive virtual reality applications.

Production and distribution of interactive multimedia educational modules on CD-ROM.

**Highlights and Accomplishments**

**Two CD-ROM products** have been developed: a multiplatform "Calculus Castle" and "Engineering Electromagnetics." Another CD-ROM in genetics, "History of the Human Gene," is also completed. The Center is actively pursuing commercialization of these products.

The center manages the Conceptual Learning of Science (CoLoS), USA project, which is a consortium of eleven universities and is sponsored by Hewlett-Packard Company.

In collaboration with John Wiley & Sons, the center continues to publish the award-winning journal, "Computer Applications in Engineering Education."

The center hosted an international conference "1996 Frontiers in Education" in Salt Lake, which had 617 attendees from 14 countries

**Summary Data:**

**Current**

| | |
|---|---|
| 1996-97 Award | $100,000 |
| Matching Funds | $338,546 |
| Patents Pending | 0 |
| Copyright Issued | 0 |
| License Agreements | 0 |
| Spin-off Companies | 0 |
| Companies Assisted | 10 |
| Industry Jobs | 0 |
| Center Jobs | 20 |

**Cumulative**

| | |
|---|---|
| Awards | $450,000 |
| Matching Funds | $1,953,779 |
| Copyright Issued | 0 |
| License Agreements | 0 |
| Spin-off Companies | 0 |

# Center for Neural Interfaces

Director: Richard A. Normann, Ph.D., University of Utah, Salt Lake City, Utah
Phone 581-8528, Fax 585-5361, e-mail: normann@cc.utah.edu

**Established in 1995, to transform the neuroprosthetic technologies developed by the Moran Laboratories for Applied Visual and Neural Science into prototype systems for future clinical applications.**

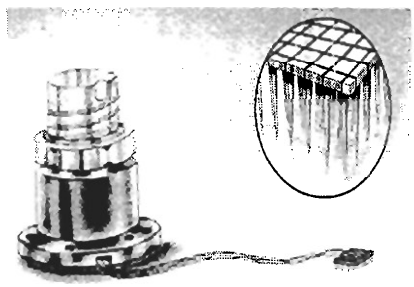
## Background

Established in 1995 to transform the neuroprosthetic technologies developed by the Moran Laboratories for Applied Visual and Neural Science into prototype systems for future clinical applications.

## Technology Development Progress

The center technologies involve the creations of arrays of microelectrodes designed to be inserted in the nervous system. These arrays are intended to provide a multichannel interface to the nervous system that will allow direct patterned stimulation of sensory pathways or the recording of neural activity from a group of neurons. Future clinical applications could include, for example, providing a sense of sight or hearing to the blind or deaf.

The center is developing methods for the insertion of the electrode arrays into the cortical tissues and associated support systems, e.g. amplifiers, electrical cabling, data acquisition software, and data analysis software.



## Highlights and Accomplishments

Several systems have been developed including a prototype 16 channel neuroamplifier system, a prototype impulse insertion system that is used to implant the electrode arrays into the cortical tissue, a prototype 100 channel neuroamplifier, and a 100 channel digital signal processor based acquisition system.

A new company, Bionic Technologies, Inc., has been formed to undertake the marketing of prototypes developed at the center to the international research community.

The company has received two Phase I SBIR awards, a total of $200,000, and first year sales are estimated at $100,000.

## Summary Data:

| Current | | Cumulative | |
|---|---|---|---|
| 1996-97 Award | $100,000 | Awards | $180,000 |
| Matching Funds | $2,138,817 | Matching Funds | $2,382,626 |
| Patents Pending | 0 | Patents Issued | 2 |
| Patents Issued | 2 | License Agreements | 1 |
| License Agreements | 1 | Spin-off Companies | 0 |
| Spin-off Companies | 1 | | |
| Companies Assisted | 5 | | |
| Industry Jobs | 9 | | |
| Center Jobs | 9 | | |

# Center for Raman Technology

Director: Dwayne Westenskow, Ph.D., University of Utah, Salt Lake City, Utah
Phone 581-6393, Fax 581-4376, email:drw@ee.utah.edu

**Raman spectroscopy is a method for analyzing the chemical constituents of sample material by detecting the wave length of light emissions generated by molecular vibrations in the sample.**

## Background

This Center was established in 1996 to commercialize Raman technology for chemical monitoring in natural gas, metal processing, and medical applications. Recent advances in instrumentation have made Raman scattering attractive as a general purpose analytical technique for measuring chemicals in solid, liquid and gaseous samples.

Raman spectroscopy is the measurement of the wavelength and intensity of inelastically scattered light from molecules. The Raman scattered light occurs at wavelengths that are shifted from the incident light by the energies of molecular vibrations. Typical applications are in structure determination, multicomponent qualitative analysis, and quantitative analysis.

The Center of Excellence for Raman Technology is a research center committed to finding new applications for Raman Spectroscopy. We are currently developing External Cavity Laser Diodes for use with these Raman systems. The focus of the Center is to develop and test new designs and methods for using Raman Spectroscopy in a wide variety of settings. Currently work is being done on applications into different gas monitoring systems.

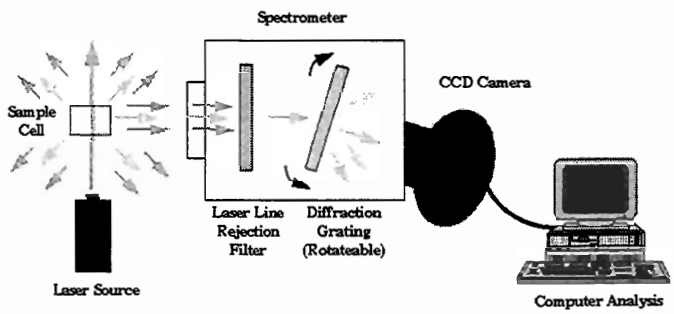
## Technology Development Progress

The technology development effort is concentrated in the following areas: laser diode configuration, sample handling schemes, fiber coupling techniques, data-analysis algorithms and modifications to the core Raman detection systems.

## Highlights and Accomplishments

The Center has submitted nine invention disclosures in the following areas: glucose monitoring, frequently diversity, external cavity laser diode, mucosal cell, neural network analysis, liquid enhancement cell, egg reflector cell, fiberoptic coupling and holographic feedback element.

The Center has developed effective collaborations with companies in steel, medical and energy industries, and has been successful in attracting several research and development contracts.




Raman Spectroscopy

## Summary Data:

| Current | | Cumulative | |
|---|---|---|---|
| 1996-97 Award | $125,000 | Awards | $125,000 |
| Matching Funds | $250,000 | Matching Funds | $250,000 |
| Patents Pending | 0 | Patents Issued | 0 |
| Patents Issued | 0 | License Agreements | 0 |
| License Agreements | 0 | Spin-off Companies | 0 |
| Spin-off Companies | 0 | | |
| Companies Assisted | 8 | | |
| Industry Jobs | 0 | | |
| Center Jobs | 4 | | |

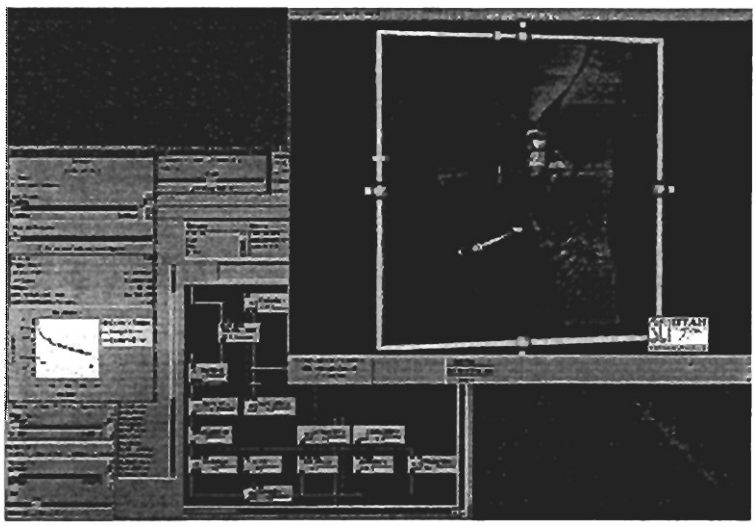
# Center for Scientific Computing & Imaging

Director: Christopher R. Johnson, Ph.D., University of Utah, Salt Lake City, Utah
Phone 581-7705, Fax 581-5843, email: crj@cs.utah.edu

**The center develops sophisticated software that allows the visualization of complex engineering and scientific simulations.**

## Background

Established in 1996, the center was created to commercialize a leading edge software system (SCIRun technology), an interactive, visually based, scientific and engineering programming environment that allows the interactive construction, manipulation, and visualization of scientific and engineering simulation.



Graphic shows an example SCIRun network, showing the dataflow programming interface, user interfaces for controlling simulation parameters, and results from a computer simulation of internal cardiac defibrillation.

## Technology Development Progress

The SCIRun technology provides scientists and engineers with a new model for scientific computing. The model relies on state of the art computing technologies including graphical user interfaces and 3D graphics to provide a visual programming and problem solving environment to investigate complex scientific and engineering problems. The program is currently being re-written for commercial use and to improve its robustness.

## Highlights and Accomplishments

The center research group has been successful in leveraging the Centers of Excellence Program investment and recognition to attract two large research grants and a research grant from ASCI to research heat-based flow simulations. The center has been selected as the first Silicon Graphics Inc. Center for Visual Supercomputing.

Dr. Christopher Johnson was the recipient of the prestigious U.S. Presidential Faculty Fellow award.

## Summary Data:

**Current**

| | |
|---|---|
| 1996-97 Award | $135,000 |
| Matching Funds | $325,814 |
| Patents Pending | 0 |
| Patents Issued | 0 |
| License Agreements | 0 |
| Spin-off Companies | 0 |
| Companies Assisted | 3 |
| Industry Jobs | 0 |
| Center Jobs | 4 |

**Cumulative**

| | |
|---|---|
| Awards | $135,000 |
| Matching Funds | $325,814 |
| Patents Issued | 0 |
| License Agreements | 0 |
| Spin-off Companies | 0 |

# Center for Self Organizing Intelligent Systems

Director: Robert W. Gunderson, Ph.D., Utah State University, Logan, Utah
Phone 797-2924, Fax 797-3054, e-mail: snowvax@cc.usu.edu

**The center investigates electronic and software systems that emulate the learning and reasoning capabilities of the human mind and applies them to commercial products**

## Background

Established in 1993 to build on its core intelligent system technologies to develop commercializable products for production and marketing to the economic advantage of the State of Utah. The center works with Utah industry to identify intelligent system solutions for new or existing commercial products. The center strives to maintain its national and international reputation as a leading contributor to the advancement of intelligent systems research.

## Technology Development Progress

During the funding period of the center intelligent systems technology has evolved to include any device and/or software concept which attempts to artificially emulate the unique cognizance and control abilities of the human mind. For example, artificial neural networks are designed to mimic the ability of the brain and central nervous system to learn and generalize from past experience.

Fuzzy logic was introduced as a way of emulating the reasoning processes fundamental to human intelligence.

Virtual presence controllers attempt to place a remote human operator or controller in a virtual environment identical to that encountered by the controlled process.

Neuro-control emulates the sensory and communication mechanisms of the human neural system.

## Highlights and Accomplishments

The intelligent robotic vehicles technology has generated several commercial products, including the **Red Rover Educational Kit and The New Red Rover Product, both being commercialized by Visionary Products Inc., Richmond, Utah and the LEGO Group A/S.** Red Rover is an educational computer driven vehicle demonstrating the exploration of hostile terrain such as on the surface of Mars.

The center also designs robotic vehicles for hazardous waste sites and for agriculture.

- New products are currently under development using the **intelligent sensors technology,** e.g., inexpensive low power ice sensors and secondary water meter.
- Intelligent irrigation controllers licensed to Campbell Scientific, Inc., Logan, Utah, have a projected sales volume of $5 million a year over a seven-year period.
- ProForm Fitness Products, Inc., Logan, Utah, estimates first-year sales of exercise equipment with center developed fuzzy-belt controller and fuzzy "spotter" to be $40 million.
- Monetary Services, Inc., Smithfield, Utah, using a center-developed neural network and computer-imaging technology, estimates a minimum of 30,000 installation sites for a device to be leased for $1,000 a month.

## Summary Data:

| Current | | Cumulative | |
|---|---|---|---|
| 1996-97 Award | $125,000 | Awards | $535,000 |
| Matching Funds | $589,500 | Matching Funds | $1,915,404 |
| Patents Issued | 0 | Patents Issued | 2 |
| Copyright Received | 0 | Copyright Received | 3 |
| License Agreements | 3 | License Agreements | 3 |
| Spin-off Companies | 1 | Spin-off Companies | 1 |
| Companies Assisted | 15 | | |
| Industry Jobs | 1 | | |
| Center Jobs | 11 | | |

# Center for Solid Oxide Fuel Cell Technology

Director: Anil V. Virkar, Ph.D., University of Utah, Salt Lake City, Utah
Phone 581-5396, Fax 581-4816, email: anil.virkar@m.cc.utah.edu

**The center explores commercially viable methods of converting gaseous fuels directly into electricity using high efficient fuel cell technologies**

## Background

Established in 1996, the main focus of the center is to develop solid oxide fuel cell (SOFC) technology for the direct conversion of chemical energy of a variety of fuels, such as natural or coal gas and other reformed logistic fuels, into electricity at a very high efficiency. Initially, the center is developing cell stack technology for a 2 to 5 kilowatt unit, which has many potential applications with emphasis on distributed power for residential and remote locations for on-demand electrical power that is clean, efficient, reliable, and noise-free.

## Technology Development Progress

The center technologies are based on the design and fabrication of novel, anode-supported solid oxide fuel cells with highly efficient electrodes that have a very low resistance. This concept makes it possible to develop a cost-effective, compact power unit for direct conversion of chemical energy of fuels into electricity for remote and residential applications.

## Highlights and Accomplishments

A patent on the development of novel electrodes for SOFC was issued. Fuel cells that operate at lower temperatures but higher efficiency are being developed. Strategic business partners are being sought.

Discussions are in progress with two Utah companies for the development and eventual commercialization of SOFC. The center has been successful in attracting research and development grants from federal agencies as well as the Electric Power Research Institute (EPRI) and the Gas Research Institute (GRI).

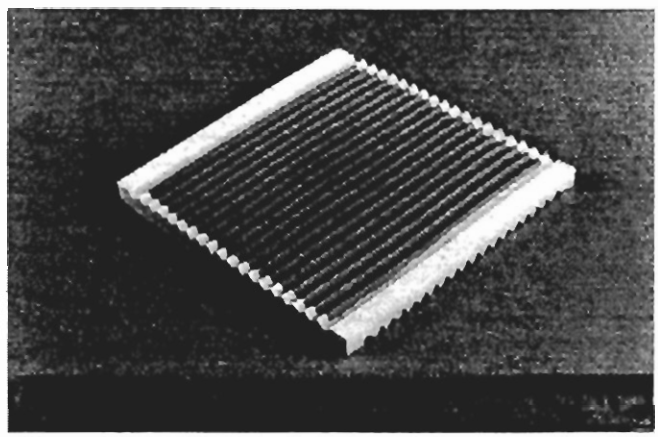


Photo of a 5cm x 5cm solid oxide fuel cell (SOFC) made by the center. The corrugations for the flow of fuel (e.g. natural gas) and oxidant (e.g.air) are in a cross-flow arrangement. The dark top surface is the cathode. SOFCs such as these are currently being configured into a stack. The objective is to construct a 2 to 5 kW stack for residential applications. The SOFC system will convert chemical energy of a variety of fuels into electricity. Several large companies, domestic as well as international, have shown interest. At the present time, a local company, which is developing business relationship with a California-based company, is in the process of negotiating technology rights.

## Summary Data:

**Current**

| | |
|---|---|
| 1996-97 Award | $100,000 |
| Matching Funds | $330,397 |
| Patents Pending | 1 |
| Patents Issued | 1 |
| License Agreements | 0 |
| Spin-off Companies | 0 |
| Companies Assisted | 2 |
| Industry Jobs | 0 |
| Center Jobs | 6 |

**Cumulative**

| | |
|---|---|
| Awards | $100,000 |
| Matching Funds | $330,397 |
| Patents Issued | 1 |
| License Agreements | 0 |
| Spin-off Companies | 0 |

# Center for Solvent Separation of Heavy Oils

Director: E. Park Guymon, Ph.D., Weber State University, Ogden, Utah
Phone 626-6953, Fax 626-7445, email: eguymon@weber.edu

**The center seeks methods for the extraction and commercialization of Utah's heavy oil deposits.**

## Background

Established in 1996, this center is focused on the development of commercially viable applications and processes for exploiting Utah's reserves of heavy oil resources, and to continue its efforts in developing hydro chemical remediation processes.

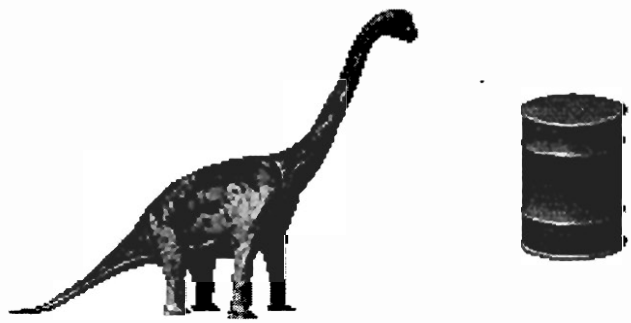
## Technology Development Progress

The technology development effort is concentrated in the following areas: production of flux oil and adhesives from the Great Salt Lake Oil, cleaning of oil from contaminated soils, removal of waste oil from engine filters and the production of high performance road asphalt from tar sand bitumen.

## Highlights and Accomplishments

A provisional patent application has been submitted for the production of Great Salt Lake high viscosity crude.

Two license agreements have been signed: first, with Crown Energy for the extraction of bitumen from tar sand; and second, with Oasis Industries for processing of used oil filters.



## Summary Data:

**Current**

| | |
|---|---|
| 1996-97 Award | $75,000 |
| Matching Funds | $180,976 |
| Patents Pending | 1 |
| Patents Issued | 0 |
| License Agreements | 0 |
| Spin-off Companies | 0 |
| Companies Assisted | 2 |
| Industry Jobs | 0 |
| Center Jobs | 3 |

**Cumulative**

| | |
|---|---|
| Awards | $75,000 |
| Matching Funds | $180,976 |
| Patents Issued | 0 |
| License Agreements | 2 |
| Spin-off Companies | 0 |

# Center for Value Added Seed Technology

Director: H. Grant Vest, Ph.D., Utah State University, Logan, Utah
Phone 797-0880, Fax 797-3376, e-mail: grant@agx.usu.edu

**The center is involved in cross-breeding research to develop drought resistant turf grasses. The center also seeks to develop vigorous hybrids of grain product that exhibit apomixis (asexual reproduction).**

## Background

Established in 1991 to produce value-added crops: (i) drought resistant turf grasses for roadways, lawns, golf courses (require 30-40% less water), (ii) forage grasses with superior yield under arid land conditions, and (iii) hybrid vigor in wheat using molecular biology.

## Technology Development Progress

- Conventional plant breeding of forage and turf grasses collected worldwide.
- Molecular genetic markers to move genes of interest from weedy grass species into commercial forage and cereal crops.
- Plant tissue culture to clone unique agricultural, horticultural and forestry plants.
- Microbiology and plant physiology to improve methods for the genetic engineering of major crops.
- Procedures to mass clone superior crop and forestry plants and to genetically engineer cereals, cotton, and other crops.

Screening grasses in saline solution...part of breeding program to develop improved grasses for resistance to high salinity that is found along roadsides in Utah

## Highlights and Accomplishments

**Plant breeding**: **A new forage grass, crested wheatgrass variety CD-2, has been released and licensed to 6 companies.** Turfgrass seed was selected for color, vegetative spread, leaf width, turf quality, response to drought and plant pests. It has been produced and is being prepared for release as a new cultivar.

**Molecular genetic marker technology**: The DNA based genetic markers for apomixis (asexual seed formation) genes are being used to tag apomictic Australian wheat grasses.

**Plant tissue culture**: proprietary tissue culture media and procedures are being refined and show promise for use in the mass cloning and genetic engineering of agronomic, horticultural, and forestry plants.

**Turf and forage grass** cultivars released by CVAST are being protected by the Plant Variety Protection Act. A significant number of companies as well as the United States Golf Association have expressed interest.

**Bioreactors:** CVAST is collaborating with federal and private labs to develop bioreactors for the cloning of crops and forestry trees and to improve genetic engineering procedures.

## Summary Data:

| Current | | Cumulative | |
|---|---|---|---|
| 1996-97 Award | $70,000 | Awards | $450,000 |
| Matching Funds | $104,972 | Matching Funds | $928,370 |
| Plant Variety Protection | 1 | Plant Variety Protection | 4 |
| License Agreements | 0 | License Agreements | 6 |
| Spin-off Companies | 0 | Spin-off Companies | 0 |
| Companies Assisted | 0 | | |
| Industry Jobs | 0 | | |
| Center Jobs | 12 | | |

# IV. Appendices

A. Financial Summary

B. Economic Impact Summary

C. FY 1997-98 Funded Centers Summary

D. News Articles

E. Legislation creating the Centers of Excellence Program

# Appendix A

## CENTERS OF EXCELLENCE - 1996/1997 FINANCIAL SUMMARY

| | State Funding 1996/1997 | Cumulative State Funding | Fed. Match 1996/1997 | Indust. Match 1996/1997 | Total Match 1996/1997 | Cumulative Total Match |
|---|---|---|---|---|---|---|
| CENTERS FUNDED IN FISCAL 1996/1997: | | | | | | |
| Advanced Combustion Engineering Research - BYU | $100,000 | $1,100,000 | $825,316 | $3,303,683 | $4,128,999 | $75,218,402 |
| Advanced Construction - U/U | $75,000 | $175,000 | $51,153 | $130,500 | $181,653 | $473,916 |
| Application Center for Materials Engineering - BYU | $125,000 | $865,000 | | $867,000 | $867,000 | $6,348,728 |
| Applied Molecular Genetics - BYU | $115,000 | $215,000 | $180,250 | $229,000 | $409,250 | $1,028,740 |
| Bioremediation - WSU | $90,000 | $90,000 | $1,400,000 | $264,200 | $1,664,200 | $1,664,200 |
| Coal Processing Technology - U/U | $100,000 | $100,000 | $308,333 | $10,000 | $318,333 | $318,333 |
| Developmental Molecular Biology - USU | $150,000 | $510,880 | $551,159 | $50,000 | $601,159 | $1,405,642 |
| Electronic Systems Technology - U/U | $150,000 | $310,000 | $350,646 | $97,929 | $448,575 | $1,561,675 |
| Genetic Improvement of Livestock - USU | $40,000 | $336,500 | $132,000 | | $132,000 | $698,985 |
| Genome Technologies - U/U | $175,000 | $175,000 | $5,516,257 | | $5,516,257 | $5,516,257 |
| Industrial Imaging - U/U | $100,000 | $200,000 | | $354,853 | $354,853 | $760,693 |
| Intelligent Computer Tools - BYU | $100,000 | $100,000 | | $553,430 | $553,430 | $553,430 |
| Minerals Technology - U/U | $115,000 | $240,000 | $335,239 | $6,176 | $341,414 | $1,011,892 |
| MTV Flat Panel Display Technology - U/U | $125,000 | $190,000 | $179,000 | $124,000 | $303,000 | $722,655 |
| Multi-Media Education Technology - U/U | $100,000 | $450,000 | | $338,546 | $338,546 | $1,953,779 |
| Neural Interfaces - U/U | $100,000 | $180,000 | $1,634,122 | $504,695 | $2,138,817 | $2,382,626 |
| Raman Technology - U/U | $125,000 | $125,000 | $92,556 | $157,444 | $250,000 | $250,000 |
| Scientific Computing & Imaging - U/U | $135,000 | $135,000 | $325,814 | | $325,814 | $325,814 |
| Self-Organizing Intelligent Systems - USU | $125,000 | $535,000 | $349,000 | $240,500 | $589,500 | $1,915,404 |
| Solid Oxide Fuel Cells -U/U | $100,000 | $100,000 | $127,699 | $202,699 | $330,397 | $330,397 |
| Solvent Separation of Heavy Oils - WSU | $75,000 | $75,000 | | $180,976 | $180,976 | $180,976 |
| Value-Added Seed Technology - USU | $70,000 | $450,000 | $79,150 | $25,822 | $104,972 | $928,370 |
| **Subtotals:** | $2,390,000 | $6,657,380 | $12,437,693 | $7,641,453 | $20,079,146 | $105,550,915 |
| CENTERS NOT FUNDED IN FISCAL 1996/1997: | | | | | | |
| All Graduated Centers | $0 | $15,377,275 | | | | $123,939,422 |
| All Distingushed Centers | $0 | $4,790,440 | | | | $71,900,382 |
| **TOTALS:** | **$2,390,000** | **$26,825,095** | **$12,437,693** | **$7,641,453** | **$20,079,146** | **$301,390,719** |
| 1996/1997 MATCHING RATIO | **8.4 : 1** | | | | | |
| CUMULATIVE MATCHING RATIO | **11.2 : 1** | | | | | |

# Appendix B

## CENTERS OF EXCELLENCE - 1996/1997 ECONOMIC IMPACT SUMMARY

| CENTERS FUNDED IN FISCAL 1995/1996: | Center Jobs | Average Salary | Industry Jobs | Average Salary | Spin-Off Companies | | Assisted Companies | Patents | | Licenses |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | New | Cum. | | Pend. | Issued | |
| Advanced Combustion Engineering Research - BYU | 138 | $31,388 | 46 | $60,461 | 0 | 6 | 172 | 0 | 2 | 60 |
| Advanced Construction - U/U | 7 | $41,600 | 9 | $41,137 | 0 | 2 | 31 | 2 | 0 | 0 |
| Application Center for Materials Engineering - BYU | 29 | $18,620 | n/a | n/a | 0 | 46 | 164 | 1 | 4 | 4 |
| Applied Molecular Genetics - BYU | 17 | $22,006 | | | | | 6 | 0 | 0 | 0 |
| Bioremediation - WSU | 10 | $22,256 | 2 | n/a | 1 | 1 | 29 | 0 | 0 | 0 |
| Coal Processing Technology - U/U | 12 | $39,966 | | | | | 10 | 0 | 0 | 0 |
| Developmental Molecular Biology - USU | 13 | $32,692 | 5 | $29,670 | 1 | 1 | 10 | 2 | 1 | 1 |
| Electronic Systems Technology - U/U | 29 | $39,517 | 3 | n/a | 1 | 2 | 27 | 2 | 1 | 1 |
| Genetic Improvement of Livestock - USU | 5 | $23,850 | 2 | n/a | 1 | 1 | 8 | 1 | 0 | 1 |
| Genome Technologies - U/U | 46 | $37,660 | | | | | 1 | 0 | 0 | 2 |
| Industrial Imaging - U/U | 4 | $54,375 | | | | | 27 | 0 | 0 | 0 |
| Intelligent Computer Tools - BYU | 15 | $29,287 | | | | | 4 | 0 | 0 | 2 |
| Minerals Technology - U/U | 4 | $43,934 | | | | | 2 | 0 | 0 | 1 |
| MTV Flat Panel Display Technology - U/U | 16 | $26,655 | 15 | $29,333 | 1 | 1 | 10 | 2 | 1 | 1 |
| Multi-Media Education Technology - U/U | 20 | $33,700 | | | | | 10 | 0 | 0 | 0 |
| Neural Interfaces - U/U | 9 | $28,222 | 9 | n/a | 1 | 1 | 5 | 0 | 2 | 1 |
| Raman Technology | 7 | $42,429 | | | | | 8 | 0 | 0 | 0 |
| Scientific Computing & Imaging - U/U | 4 | $18,460 | | | | | 0 | 0 | 0 | 0 |
| Self-Organizing Intelligent Systems - USU | 9 | $36,680 | 3 | n/a | 1 | 1 | 15 | 0 | 5 | 3 |
| Solid Oxide Fuel Cells -U/U | 6 | $51,405 | | | | | 2 | 1 | 1 | 0 |
| Solvent Separation of Heavy Oils - WSU | 3 | $21,466 | | | | | 2 | 1 | 0 | 2 |
| Value-Added Seed Technology - USU | 12 | $31,356 | | | | | 0 | 1 | 4 | 6 |
| CENTERS NOT FUNDED IN FISCAL 1995/1996: | | | | | | | | | | |
| All Graduated Centers | 542 | $30,323 | 477 | $33,550 | | 45 | 303 | | 44 | 49 |
| All Distingushed Centers | 149 | $27,128 | 478 | $35,947 | | 16 | 19 | | 31 | 27 |
| **TOTALS:** | **1106** | **$30,539** | **1049** | **$35,201** | **7** | **123** | **865** | **13** | **96** | **161** |

Note: Information on industry jobs, average salary etc. is not available for Centers that have not as yet spun-off companies

# UTAH CENTERS OF EXCELLENCE PROGRAM

***Department of Community and Economic Development***

The following **Centers of Excellence** have been **funded during the fiscal year July 1, 1997 through June 30, 1998.** They are listed to provide basic information on current funding as of October, 1997. The full report of centers activity for this fiscal year will be published in December 1998.

## 1997-98 Active Centers

| CENTER | P.I. | Inst | Contact Numbers | Brief Description |
|---|---|---|---|---|
| Advanced Construction Materials | Hosin Lee | U/U | (801) 585-3512<br>Fax (801) 585-5477<br>hlee@civil.utah.edu | Serves as a testing and evaluation center for construction materials and expedites the commercialization of new construction products in the marketplace. |
| Asynchronous Circuit and System Design | Chris Myers<br>Erik Brunvand | U/U | (801) 581-6490<br>Fax (801) 581-5281<br>myers@ee.utah.edu<br>(801) 581-4345<br>Fax (801) 581-5843<br>elb@cs.utah.edu | Facilitates the systematic asynchronous and self-timed computer-assisted design tools into viable commercial products. |
| Applied Molecular Genetics | Robert Park | BYU | (801) 378-6871<br>Fax (801) 378-4211<br>robert_park@byu.edu | Transfers DNA technology from research laboratories to targeted plant and animal industries to identify superior breeding stock and increase the accuracy of their selection at a much-reduced cost. |
| Bioremediation | D. Jack Adams | WSU | (801) 626-6058<br>Fax (801) 626-7467<br>djadams@weber.edu | Focuses on the final development and commercialization of improved methods for hazardous heavy metal removal and recovery from solutions, soils, sediments. |
| Cell Signaling | Glenn Prestwich | U/U | (801) 581-7063<br>Fax (801) 581-7087<br>gprestwich@deans.pharm.utah.edu | Focused on technologies important to the treatment of cancer, allergy, asthma, and inflammation. Near-term products for commercialization include chemical agents developed in the center. |
| Coal Processing Technology | Jan Miller | U/U | (801) 581-5160<br>Fax (801) 581-8119<br>jdmiller@mines.utah.edu | Developing a technology base that will lead to the development of a large fossil resin industry for central Utah, as well as advanced coal-cleaning technologies. |
| Developmental and Molecular Biology | Kenneth White<br>John Morrey | USU | (435) 797-2149<br>Fax (435) 797-2118<br>kwhite@cc.usu.edu<br>(435) 797-2622<br>Fax (435) 797-2766 | The main focus is on the production of valuable proteins at sufficiently lower costs to penetrate vast new market opportunities by utilizing genetically-engineered transgenic animals. |
| Electronic Systems Technology | R. Jennifer Hwu | U/U | (801) 581-6954<br>Fax (801) 581-8541<br>hwu@ee.utah.edu | Works with industry to design and produce specific industrial-oriented electronic systems to enhance production and competitiveness. This enables industry to apply advanced university talent to industrial "real-life" problems. |

| CENTER | P.I. | Inst | Contact Numbers | Brief Description |
|---|---|---|---|---|
| Harsh Environment Electronics (Formerly MTV Flat Panel Displays) | Laurence Sadwick | U/U | (801) 581-8282<br>Fax (801) 581-5281<br>sadwick@ee.utah.edu | Makes low-cost, high yield microminiature thermionic vacuum emitters to perform the function of cathode ray tubes and matrix liquid crystal displays. Commercializing technologies related to high-speed digital and analog highpower and microwave electronics, microminiature thermionic converters, and flat-panel displays. |
| Industrial Imaging | Robert Ehrlich | U/U | (801) 581-5906<br>Fax (801) 585-3540<br>behrlich@egi.utah.edu | Focused on the commercialization of a series of image analytical algorithms within a variety of industrial fields, particularly environmental assessment and medical imaging. |
| Intelligent Computer Tools | Bill Barrett | BYU | (801) 378-7430<br>Fax (801) 378-7775<br>barrett@cs.byu.edu | Applies the use of intelligent computer tools for digital image composition, digital library creation, and creation of an interaction with virtual environments. |
| Minerals Technology | Peter King | U/U | (801) 585-3113<br>Fax (801) 581-8119<br>rpking@mines.utah.edu | Developing technologies in comminution, or size reduction, used to extract minerals from mineral ores to produce aggregates for the construction industry, fine powders for manufacturing, and pulverized fuel for electric power generation. |
| Multimedia Education and Technology | Magdy Iskander | U/U | (801) 581-6944<br>Fax (801) 581-5281<br>iskander@ee.utah.edu | Commercializes interactive multimedia CD-ROM products for education and implements research and development to examine the feasibility of using virtual reality technology in education and corporate training. |
| Neural Interfaces | Richard Normann | U/U | (801) 581-7645<br>Fax (801) 581-8966<br>normann@cc.utah.edu | Developing neuroprosthetic systems that will provide the restoration of limited sensation to the profoundly blind or deaf or to provide enhanced interaction of quadriplegics with their environment. A company has been formed to manufacture and distribute research tools. |
| Raman Technology | Dwayne Westenskow | U/U | (801) 581-2478<br>Fax (801) 581-4367<br>drw@ee.utah.edu | Exploring applications for the commercial use of Raman technology for chemical monitoring in industrial processes and medical applications. It can be used as a general-purpose analytical technique for measuring the chemicals in solid, liquid, or gaseous samples. |
| Scientific Computing and Imaging | Christopher Johnson | U/U | (801) 581-7705<br>Fax (801) 581-5843<br>crj@cs.utah.edu | Commercialization of the SCIRun Software System, a visually-based programming environment that allows the interactive construction, manipulation, and visualization of scientific and engineering simulations. |

| CENTER | P.I. | Inst | Contact Numbers | Brief Description |
|---|---|---|---|---|
| Self-Organizing Intelligent Systems | Robert Gunderson | USU | (435) 797-2924<br>Fax (435) 797-3054<br>snowvax@cc.usu.edu | Helps Utah industry develop marketable products using the technology of self-organizing intelligent systems and to establish itself as a world leader in intelligent systems research. |
| Solid Oxide Fuel Cell | Anil Virkar | U/U | (801) 581-5396<br>Fax (801) 581-4816<br>anil.virkar@m.cc.utah.edu | Researches electrochemical devices which can convert chemical-free energy of combustion of a fuel, such as natural gas or hydrogen, directly into electricity at very high efficiencies. |
| Solvent Separation of Heavy Oils | Park Guymon | WSU | (801) 626-6953<br>Fax (801) 626-7445<br>eguymon@weber.edu | Applications of solvent/surfactant technology for rapid separation of heavy oils without heat, with minimal environmental damage, lower cost, and enabling the heavy oil to be recovered for commercial uses. |
| Utah Genome Technologies | Robert Weiss | U/U | (801) 585-3435<br>Fax (801) 585-7177<br>bob.weiss@genetics.utah.edu | Exploring commercial applications for large-scale DNA sequencing and to complete the determination of sequences of human and a number of model organisms. Its broad application will be to reveal the patterns of inheritance in families. |
| Value-added Seed Technology | H. Grant Vest | USU | (435) 797-0880<br>Fax (435) 797-3376<br>grant@agx.usu.edu | Develops technologies and value-added crops and turf grasses to be marketed for the economic development of Utah-based agricultural and recreational industries. |

*For more information:* *Centers of Excellence Program*
*Department of Community and Economic Development*
*324 South State Street, Suite 500*
*Salt Lake City, Utah 84111*
*(801) 538-8770*
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*E-mail: ecox@dced.state.ut.us*
*Web site: http://www.dced.state.ut.us/techdev/welcome.htm*

The Herald Journal
October 6, 1996

**APPENDIX D.1**

# It's all in the genes

Sunday spotlight

## USU gives nature a helping hand

By Jenie Skoy
staff writer

Bang's disease may no longer be a threat for cows if researchers at Utah State University have their way.

Professors William Reed and Kenneth White, along with the Center for Developmental and Molecular Biology at USU, have been awarded a patent for constructing a unique gene. When injected into hundreds of mice embryos, this gene is producing mice — and their offspring — that are more resistant to bacteria.

The gene makes the mice's "white blood cells nastier," said White, head researcher for the gene enhancement project.

Successful mice experiments are a first step, said White. He hopes the research may arm other animals, like goats and cows, with the same kind of disease resistance.

"Instead of carrying around a .22, they are carrying around a .44 Magnum, "said White.

This idea of combining genes and incorporating them into plants and animals is not new. Supermarkets sell many products — fruit, vegetables and milk — that have been enhanced through genetic engineering. Researchers have also performed many transgenic (transferring genes from one species to another) experiments, but mostly on plants.

The application of transgenic animal research has been used mostly in the medical field for gene therapy to treat people with specific diseases. Though many similar experiments have been performed, White and Reed say their idea of constructing a specific gene to target immune responses in animals is a unique one. And it's one that has effectively produced mice that are resistant to bacteria.

USU researchers infected mice with the bacterium, Brucella abortus, that causes brucellosis, or Bang's disease.

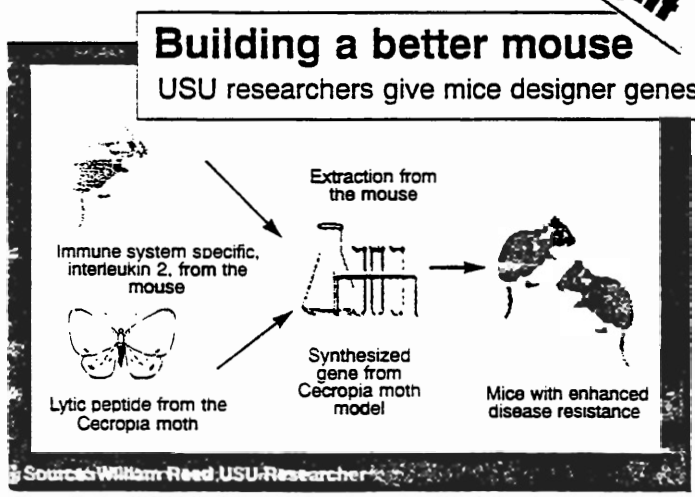
After they tested all the mice, those that expressed traits of the "new gene" showed a significant reduction in the Brucella abortus bacterium — approximately 50 percent, compared with the control group. If researchers could make livestock express and pass on this gene to their offspring, the finding would be "great news," said Vic Saunders, vice president of communications at the Utah Farm Bureau.

Because there are stringent inspections on cattle coming into the state, Utah is considered "brucellosis free," Saunders said. However, other areas of the nation's cattle industry have been crippled by this widespread disease.

Finding a method to resist the disease would be comparable to finding a way to resist the AIDS virus in humans, said Saunders.

To construct the gene, White, Reed and John Morrey — with colleagues from the University of Louisiana — made a synthetic version of the structural part of a gene found in the cecropia moth. During metamorphosis, this moth turns on a series of genes — a cecropian class of lytic peptides — that help it fight infection by parasitic organisms. Researchers in the Netherlands, Sweden and Switzerland first identified this moth, said Reed.

The research team added these synthetic lytic peptides to an area in the mammal that would express an immune response. One of the first compounds turned on in the immune systems of mammals is Interleukin-2. These two gene parts (lytic peptide and Interleukin-2) successfully expressed at the same time, creating a new gene, "one the animal would not have thought of creating," said Reed.




What could this new gene mean for agriculture? Reed said when he told farmers about the idea, they asked, "Great, when can I get a cow?"

People regularly get patents for constructing genes, but the practical application of such research is often complicated and lengthy.

Effectively breeding cows that are genetically resistant to disease may be a long haul, said Reed. "It will work theoretically," he said, but the practical use may be "10 to 20 years down the road."

"For most of these guys (farmers) — they're not going to see it in their lifetimes."

The gene enhancement research was funded with $150,000 from the Center of Excellence and "roughly $300,000 from other sources, mainly federal," said White.

Others on the project include USU researchers Reed Holyoak, Tom Bunch and graduate students.

The Salt Lake Tribune
March 28, 1997

**APPENDIX D.2**

Lynn R. Johnson/The Salt Lake Tribune

Cancer researcher Sean Tavtigian in the lab at Myriad Genetics in Salt Lake.

# Utahns Help Find Gene That Turns Some Cancers Deadly

BY LEE SIEGEL
THE SALT LAKE TRIBUNE

Utah and Texas scientists and their New York rivals announced Thursday they discovered a gene that normally suppresses tumors but can mutate to make brain, breast, prostate, kidney and skin cancers turn aggressive and deadly.

The discovery "sets out a fairly clear path to developing drugs that might reduce or block the aggressive spread of a variety of different cancers," said gene co-discoverer Sean Tavtigian, a molecular biologist and cancer-research director at Myriad Genetics Inc. in Salt Lake City.

"Testing for mutations of this gene in tumors might help predict how aggressively those tumors have or will soon spread, which would be valuable information for physicians in examining treatment options."

Myriad already is developing a test to identify aggressive cancers. But it will take years to understand how the gene works and develop medicines to prevent cancers from becoming more malignant, said cell biologist Peter Steck and physician Ramon Parsons.

■ A race among researchers A-18

See DISCOVERY, Page A-18

## Discovery May Lead to Cancer Drugs

■ Continued from A-1

The gene on chromosome 10 was discovered independently by Parsons' group at New York's Columbia University, and by another team led by Steck and Tavtigian. Steck works at the University of Texas M.D. Anderson Cancer Center in Houston. The achievement was announced Thursday at news conferences in New York and Houston.

Parsons' team published its findings in today's issue of the journal *Science*. Steck and Tavtigian's findings will be published Tuesday in *Nature Genetics*.

"Discoveries such as this are rapidly filling in the missing pieces of the cancer puzzle," said Richard Klausner, director of the National Cancer Institute. "This discovery represents one of the first genes to be implicated in aggressive and generally fatal brain tumors, a type of cancer in which we desperately need clues."

Both studies found the gene often is mutated in glioblastoma multiforme, which Steck called "the most common and most lethal tumor of the brain. They are almost universally fatal within two years."

Each year, 19,000 Americans are diagnosed with primary brain tumors — cancers that start in the brain. Steck said 11,000 are glioblastomas, the most deadly form of astrocytoma, a kind of cancer also called glioma because it attacks glial cells that support the brain's nerve cells.

Tavtigian estimated the mutant gene also is found in a fourth of breast, prostate, kidney and melanoma skin cancers, and in a higher proportion of the advanced stages of those cancers.

The researchers suspect the mutant gene also will prove to play a role in making many other low-grade cancers turn more aggressive and spread, he added.

"We found a gene that in its unmutated state helps prevent cancers from spreading aggressively," Tavtigian said. "Once it has become mutated, the cancers spread more aggressively."

Cancer is a multistep process involving many gene mutations and environmental and lifestyle factors. Some mutant cancer genes are inherited and make carriers susceptible to cancer. Other genes — like the new one — are usually inherited in their normal form, but can mutate during a person's lifetime to trigger or aggravate cancer.

"If you imagine it takes 10 mutations one after another — each changing a different gene — to go from a normal cell to an aggressive cancer, a mutation in this gene might be the eighth or ninth step," Tavtigian said.

The Texas-Utah team named the gene MMAC1 (mutated in multiple advanced cancers 1). The New York group named it PTEN because of its links to phosphatase and tensin enzymes and its location on chromosome 10. An international committee ultimately will choose the final name.

Researchers suspect the tumor-suppressor gene normally produces a phosphatase enzyme that blocks another enzyme responsible for the uncontrolled growth or spread of cancerous cells. When mutated, the gene fails to suppress tumors and allows cancers to become more aggressive.

By learning exactly how the normal gene's enzyme blocks the progression of cancer, researchers hope to develop new drugs to do the same thing.

Researchers now have found 17 genes that normally suppress tumor growth. *Science* said the new gene may be among the most important.

Parsons said when the same gene is inherited in mutant form, it may be responsible for Cowden's syndrome, which can lead to breast cancer at a young age.

Discovery of the gene culminates a decade of work by Steck who identified its approximate location and found a piece of it, but then asked Myriad to help find the entire gene. Parsons had been searching for only about a year before his team also found it.

Members of Tavtigian's Myriad team credited with helping discover the gene are molecular biologists Michelle Baumgard, Thomas Hattier, Thayion Davis, Cheryl Frye, Rong Hu, Bradley Swedlund and David H.F. Teng.

# USU RAISES THE `STEAKS' IN MEAT MARKET

*Smith's butcher Tom Kvenvold stocks a package of FlashGril'd steaks at the grocery store in Sandy. The steaks were developed at Utah State University as a low-fat, quick-cooking alternative to chicken. (Rick Egan/The Salt Lake Tribune)*

**BY LISA CARRICABURU**
**THE SALT LAKE TRIBUNE**

. LOGAN -- Utah State University food scientist Von Mendenhall's research goal in 1987 was to make the low-fat food market meatier.

. A decade later, a restructured beefsteak product he developed is trying to muscle its way into markets in the United States and abroad with the help of nearly $1.03 million in state technology-development grants and $2.4 million in federal and industrial matching funds.

. Lonny Adams, AgriProducts Inc. president and chief executive officer, says the product for which his Salt Lake City company holds the North American license may be the most expensive food product ever developed in Utah. He estimates AgriProducts Inc. has spent another $4 million taking brand-name FlashGril'd steaks to market.

. But he adds it also could become the state's most profitable home-grown food.

. ``The market is a bottomless pit,'' Adams says. ``This product has multimillion-dollar potential.''

. The idea behind FlashGril'd steak was to develop a process that could make beef, pork and lamb as viable a low-fat, fast-food option as chicken. Another goal was to find a way to add value to cuts of meat that commands lower prices because they are fatty or tough, says Dick Whittier, USU meat laboratory manager.

. ``There are cuts of beef, for example, that are palatable and nutritious but nature didn't shape them in a form that makes a good steak,'' he says.

. Mendenhall's answer is a process whereby morsels of meat first are separated from all fat and connective tissue by hand. The meat then is mechanically tenderized before being placed in a vacuum tumbler where fat or flavoring can be added before it is re-bound with natural meat proteins.

. Steaks are created by pressing the meat into stainless-steel forms in shapes and sizes that can be dictated by the customer, Whittier says. The final step involves searing the product in a 1,200-degree oven that imprints grill marks on the meat before the product is frozen for storage and shipping.

. The result is an easy-to-prepare, low-fat steak that can be cooked by frying for four minutes on each side. It is uniform in size and tender yet still flavorful.

. ``It is totally edible,'' Mendenhall says.

. Whittier adds the process addresses all the inconsistencies in nonprocessed steak that the average consumer complains about, such as varying tenderness and flavor.

**(Continued Appendix D.3)**

. Not everyone finds the product as appetizing, however.

. Ronnie Cummins, national director of the Minnesota-based Pure Food Campaign, says the product belongs in a category of overly processed food that many consumers avoid.

. ``People want safe, real food that is not precooked or tampered with technologically before it reaches them,'' he says. ``It is questionable whether this qualifies.''

. But Whittier counters the restructured steak was developed with customers' demands in mind.

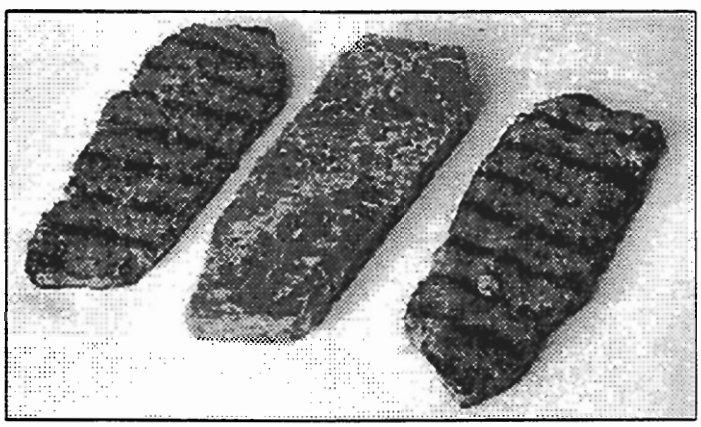
. ``Mainstream consumers want consistent quality in the food they eat,'' he says. ``That is exactly what this product is about. Not everyone will want it, but a lot of people will.''

. A group of investors that includes the state and federal governments is banking on its popularity.

. Mendenhall's restructured-steak idea and another research project exploring genetic improvements that may help ranchers produce sheep with meatier hindquarters make up USU's Center of Excellence for Meat Processing Technology.

. Since 1991, the center has received $1.03 million in state funds set aside by the Legislature to develop technologies with economic promise for the state, says Roderick Linton, director of the Utah Department of Community and Economic Development's Office of Technology Development.

. The Center of Excellence Program that in fiscal year 1996 contributed $2.3 million to 20 active centers requires that state grants be matched 2 to 1 with federal or private funds. Linton says the USU center has more than accomplished that requirement, having received $2.41 million in matching funds since 1991.



*The raw restructured beefsteak is flanked by two versions that have been seared in a special oven. (USU News Services)*

. Fifty-two percent of the matching grants during the five-year period came from the federal government, including about $1.1 million from the U.S. Department of Agriculture, he says. Omaha, Neb.-based ConAgra Inc., parent company of E.A. Miller, which operates a Cache County meat-packing facility, was the largest private donor, having contributed $667,000. Other private investors include the National Meat Board and the National Livestock Board.

. From the state's perspective, the project already is a success, Linton says.

. ``A research university has received patents and signed licensing agreements and is seeing technology it developed successfully marketed in the private sector," he says. ``That is precisely the scenario we seek."

. AgriProduct's Inc.'s Adams also is happy with early results.

. FlashGril'd steaks, which sell for about $1.40 per average-size steak, were test-marketed in Florida sports bars last spring and fed to the press corps at the 1996 Summer Olympics in Atlanta in July.

. The company since has found brokers for the product throughout the United States and Canada. Adams says he primarily is targeting restaurants and small fast-food chains that may use the steaks in sandwiches, fajitas and similar dishes.

. In Utah, Smith's Food & Drug Centers Inc. last weekend began selling the steaks in 10 stores in packages of four selling for about $7. It may add them in others if the product proves successful, says Shelley Thomas, store spokeswoman.

. Adams says AgriProducts has three ovens to process the product, each of which is capable of daily producing 1,000 pounds of FlashGril'd steak. Production currently is contracted out, but a new production facility is being built in Salt Lake City that he expects to open as early as April with about 25 employees.

. A separate company, Bakker/QuickGrill Products B.V. of Holland, has the license to market the product in Europe. Both bought licenses from USU and are obligated to return a percentage of their sales to the school.

. Linton says royalties paid by private companies back to Centers of Excellence typically range from 4 percent to 5 percent of gross sales.

. ``It's a winning proposition for everyone," Adams says.

. Newer research under way at USU is similarly motivated.

. Mendenhall is studying ways to use ultra-high temperature (UHT) processing to tenderize beef, pork and lamb.

. A process under development involves using UHT to pasteurize the surface of meat without affecting the natural muscle enzymes that tenderize the product. When packaged in carbon dioxide, meat treated with the process can be stored for up to 80 days while the natural enzymes do their job.

. The product then can be eaten after being microwaved for just more than a minute.

. Whittier says USU is looking for industry partners to help support the project.

The Salt Lake Tribune **BUSINESS** Wednesday, December 3, 1997

# S.L. Factory Makes Engineered Steak

**APPENDIX D.4**

BY LISA CARRICABURU
THE SALT LAKE TRIBUNE

Agri-Products Inc. has opened a new Salt Lake City plant to make a restructured beefsteak product developed at Utah State University's state-funded Center of Excellence for Meat-Processing Technology.

Grand-opening ceremonies for the 17,000-square-foot facility at 1750 S. 500 West are at 1 p.m. today, although the plant started operations last week, said Lonny Adams, Agri-Products chief executive officer.

The facility employs 25 workers who use patented technology to make FlashGril'd Steak, a pretrimmed, portion-controlled steak that is low-fat and contains no bone or gristle. Adams said he anticipates increasing the work force to 42 within a year as production increases.

Workers initially will make 250,000 pounds annually of FlashGril'd Steak. Adams said the facility has the capacity to produce 1 million pounds per year as demand grows.

The product, which previously was made through a contract arrangement with a Davis County meat packer, is distributed in the United States and Canada through 60 food-service companies to clients such as Disney World, Universal Studios and Amtrak.

Agri-Products earlier this year began selling FlashGril'd Steak at some Smith's Food & Drug Center stores in Utah for about $7 per four-pack, but it no longer is available there. Adams said his company is repackaging the steak for retail and hopes to have it in Smith's, Albertson's and other U.S. grocery chains soon.

"It's doing well," he said. "It's exceeded all our expectations."

The product was created by USU researchers who sought to develop a process that could make beef as viable a low-fat, fast-food option as chicken. They also sought to find a way to add value to cuts of meat that command lower prices because they are fatty or tough.

The process they developed involves first separating morsels of meat from fat and connective tissues. The meat then is mechanically tenderized before being placed in a vacuum tumbler, where fat or flavoring can be added before it is re-bound with natural meat proteins.

Steaks are created by pressing the meat into stainless-steel forms. The final step involves searing the product in a 1,200-degree oven that imprints grill marks on the meat before it is frozen for storage and shipping.

Adams said the process removes beefsteak features about which consumers complain.

"You need a knife and fork to enjoy even the few steak sandwiches offered on a menu today," he said. "The FlashGril'd product solves these problems without sacrificing texture or flavor."

The USU center, which also explored genetic improvements that may help ranchers produce sheep with meatier hindquarters, received about $1.03 million in state funds and $2.41 million in federal and private matching funds for its projects, according to the Utah Department of Community and Economic Development's Office of Technology Development.

In turn, Agri-Products pays royalties back to the state on sales of the product.

"The end product is good for Utah agriculture, good for Utah education and good for Utah business," said Randy Parker, marketing director for the Utah Department of Agriculture and Food, which has helped promote FlashGril'd Steak in the United States and abroad.

Adams said Agri-Products eventually hopes to expand its line to include pork, lamb and buffalo.

**APPENDIX D.4**

# Starting a business? Try Utah

State officials aggressively woo new high-tech companies

By Craig Wirth
CNBC
Rob Linton, Office of Technology Development

SALT LAKE CITY — Where is the best place to start a small business?

If you guessed the inter-mountain area of the West — you're on target — especially if the business is in the exploding high-tech industry. Forbes and Financial World list Salt Lake City as the No. 1 location to start a high-tech company.


CNBC

Companies such as Novell, Iomega, Evans and Sutherland and Wordperfect all started as Utah entrepreneurial dreams. Today there are 1,500 high-tech companies spinning their hard drives in Utah. Many are small businesses that prosper under aggressive state economic development programs design to target new companies.

"The emphasis we know is on small business," said Rod Linton, Director of Utah's Office of Technology Development, "because it's the best way we know to create jobs."🔊Linton says the state's strategy of targeting new business is central to its economic policy.

Universities traditionally supply most high-tech research, so Utah took its pro-business approach to academia.

"We have engaged consultants to go to the professors to bring business to the table," Linton said.

Working together, state government and universities put up research parks to house small businesses. That effort — combining cutting edge technology with business — is one of the biggest factors that puts Utah at the top of many entrepreneurial lists for start ups.

R. Thayne Robson, Director of the Bureau of Economic and Business Research


CNBC

"We talk academic capitalism," said R.Thayne Robson, Director of the Bureau of Economic and Business Research at the University of Utah. "Twenty-five years ago, most universities discouraged professors from starting up companies."

🔊Today, said Robson, the rapid pace of technology flowing from academic labs is seen as an obvious source of economic growth.

*"It's the best way we know to create jobs."*
— ROD LINTON
Dir., Utah Office of Technology Development

That approach of leveraging the state's academic resources helped bring Dinesh Patel to Utah to start a high-tech, biomedical company, TheraTech Corp. University professors had developed new technology for high tech drug patches, and the state encouraged their commercial development. Patel also says small business emphasis he found at the state-supported research park helped him get financing for his company.

"Having market capitalization of $200 [million] to $300-million, I'd be lost in Silicon Valley. Just a blip on the screen," Patel said. "But here I am a high-profile company with access to state and local government."

State officials say that the technology industries are now built largely on these new companies — as old technology companies downsize, new technology companies grow. So they spend a lot of time nourishing the new.

So far, the policy has worked for both Utah and budding entrepreneurs. Gov. Michael Leavitt says the state is committed to keeping up its reputation of being friendly to small business.

Michael Leavitt,
Governor of Utah

**Governor Mike Leavitt**

"Eight-five or 90 percent of expansion comes from new ideas, not from businesses transferring from one city to another of manufacturing facilities," said Leavitt. Leavitt says the Utah's efforts at generating jobs from new technology starts in the state-funded public school system.

Utah now has 45 thousand high-tech jobs. And high tech has now replaced defense and aerospace in size. One small company at a time.

"Technology is dynamic," said Robson. "Start-ups are at the edge of that technology and that is where the growth is in."

What can other states learn from Utah's example? Leavitt attributes part of the state's early success to chance. But the success of the first generation of technology companies helps lay the groundwork for the next generation of start-ups.

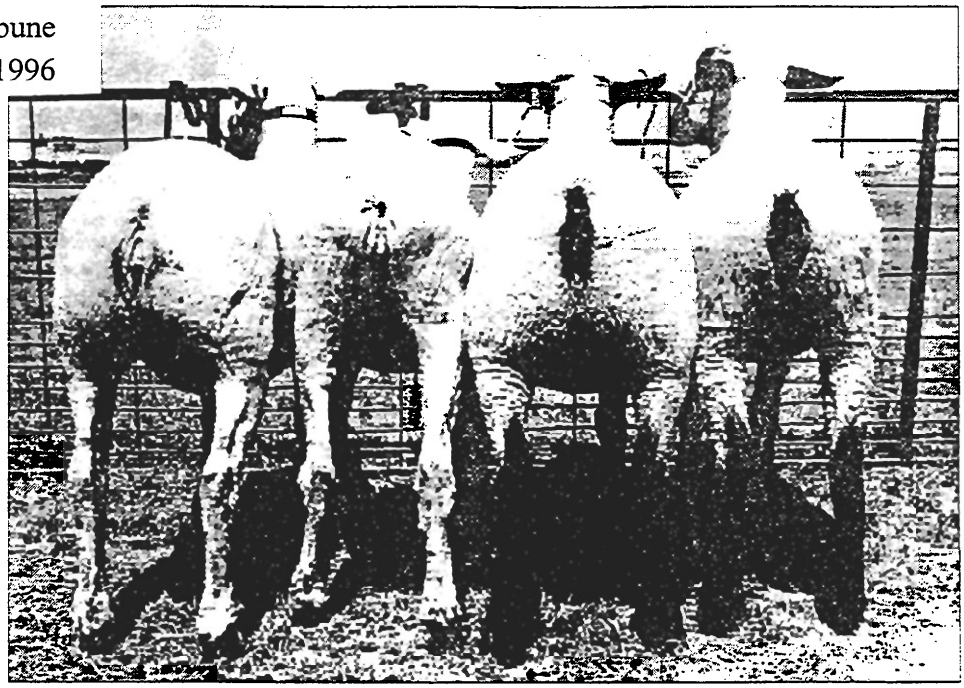
"I think we were lucky in the beginning," he said. "Novell and Wordperfect, for example, created a technology infrastructure.

That infrastructure is now creating new chips off the old computer block.

Utah realizes many of today's entrepreneurs are in the high-tech sector. And the state wants them to plug their computers in here.

Salt Lake Tribune
July 15, 1996

**APPENDIX D.5**



The first and third sheep, from left, have developed big butts because of a mutant gene inherited only from the male, researchers at Utah State University have discovered.

# USU Researchers Hope Their Work Can Lead to More Marketable Sheep

BY LEE SIEGEL
THE SALT LAKE TRIBUNE

Utah State University researchers have solved a mystery: why some sheep with the "beautiful buttocks" gene develop hefty hindquarters, yet others have only petite posteriors.

The discovery should help livestock producers raise lambs with less fat and up to 30% more meat in their buttocks. It also might help explain strange patterns by which some human diseases are inherited.

The study was published Friday in the journal *Science* by molecular geneticist Noelle Cockett and colleagues at USU, Texas Tech University in Lubbock, the University of Liege in Belgium and the U.S. Sheep Experiment Station in Dubois, Idaho.

The sheep carry a trait named callipyge, which was discovered in 1983 in an Oklahoma ram that had "muscular hypertrophy" — scientific jargon for big, meaty buttocks. Ten years later, Cockett and colleagues discovered the mutant gene responsible for the trait was located on sheep chromosome 18. The gene also was named callipyge, which is Greek for beautiful buttocks. Cockett uses French pronunciation: calleh-peej.

Scientists initially assumed the trait was inherited in a conventional or Mendelian manner, namely, that lambs would have big buttocks if they inherited the callipyge gene from either the ram, the ewe or both. But lamb producers complained they were getting too few lambs with big backsides.

Cockett and other researchers did a series of breeding experiments in which they tried to produce lambs with large buttocks. They also discovered a genetic "marker" that reveals which sheep actually inherited the callipyge gene, and they tested blood from the sheep for that marker.

The experiment revealed an unusual inheritance pattern for the callipyge gene and the big-buttocks trait. If both the mother and father passed on the gene, or if just the mother did, the lambs also carried the gene but didn't have big buttocks. Lambs developed big buttocks only if the father passed on the mutant gene and the mother didn't.

"If the gene comes from the mother, it is turned off in her offspring, regardless of what dad passes on," said Cockett, a professor of animal science. "We've clarified the inheritance of the big-butt trait so producers can get all the big-butted lambs they want," simply by mating rams that carry the callipyge gene with ewes that lack it.

Producers can identify callipyge rams even if they don't have large buttocks by having their blood tested to see if the genetic marker is present. Producers are eager to breed lambs with large buttocks if researchers can overcome a problem: the meat tends to be tough. Cockett, however, is confident meat-aging and processing methods can produce tender meat from callipyge lambs.

Aside from its practical implications, Cockett said her study is important scientifically because "it's a novel genetic inheritance pattern" called polar overdominance. It previously had been observed only in one species: mice with a mutation that makes them die before birth, but only if they inherit the mutant gene from the mother and not from the father.

Similar odd inheritance patterns might explain why some human diseases seem to be complex, multi-gene diseases when, in fact, they are caused by a single mutant gene, Cockett said.

Carmen Sapienza, a geneticist at Temple University Medical School in Philadelphia, said one such possibility is Beckwith-Wiedemann syndrome, which produces large babies with a high risk of childhood cancer. It almost always is inherited from mothers rather than fathers with the mutant gene.

Cockett and colleagues are trying to discover the exact location of the callipyge gene. Animal scientists hope it might be transferred into pigs and cattle to give them meatier rumps.

DESERET NEWS, WED. P.M./FRI. A.M., NOV. 26, 28, 1997

# U. spinoff could help blind see, deaf hear

**By Roger Pusey**
Deseret News staff writer

Had it not been for funding from the state's Centers of Excellence program, a company spun off from technology developed at the University of Utah might not be working toward helping the blind see, the deaf hear and physically challenged people lead near-normal lives.


That word comes from Brian Hatt, president of Bionic Technologies Inc., a company that for now is selling its products to other researchers. The company eventually wants to commercialize its products for use on humans who are blind, deaf or have central nervous system problems.

Hatt said money from the Centers of Excellence program to the Center for Neural Interfaces at the U. of U. helped develop the technology to the point where the company was incorporated 18 months ago.

Company officials decided several months ago that marketing their products to other researchers would help people overcome their health problems.

To determine if there was any interest in the technology, company employees went to a trade show. Their booth created bedlam because of the possibilities of the technology, Hatt said.

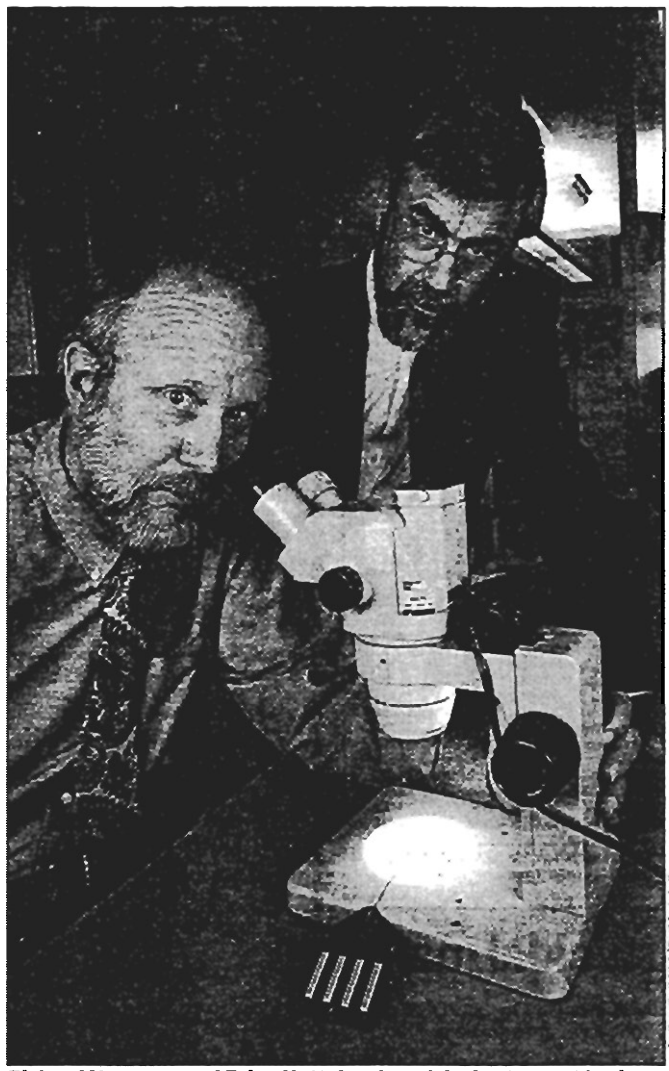
The company is now in phase two of a business plan that includes standardization of the manufacturing process, increasing sales to the research community and continuing to pursue research money from several sources, Hatt said. He said the next phase will be to experiment with the neural products on humans.

Up to now, experimentation of a device called an array has been with cats. The array is as big as a medium-sized button and contains 100 tiny sharp points. It is "shot" into the brain with a special device and the neural responses are recorded.

Richard A. Normann, director of the Center for Neural Interfaces, said nervous-system disorders are the nation's biggest health-care problem, outpacing heart disease and cancer. This is an indication of the number of people who could be helped if the new technology becomes available for humans.

He said the devices developed at the center and being manufactured by the company could help restore sight and hearing and help people with their motor skills rehabilitation.

Miniature television cameras already in use could be attached to a pair of glasses and wires to the array could be implanted in the brain in the area that governs sight, Normann said, which could help blind people see. The company is sseveral years away from testing the devices on humans if regulatory approval is granted, he said.



LAURA SEITZ, DESERET NEWS

**Richard Normann and Brian Hatt developed device to treat brain.**

LEGISLATION FORMING THE CENTERS OF EXCELLENCE PROGRAM

# PART 6
# Centers of Excellence

**9-2-601.Purpose.**

(1) The Legislature recognizes that the growth of new industry and expansion of existing industry requires a strong technology base, new ideas, concepts, innovations, and prototypes. These generally come from strong research colleges and universities. Technical research in Utah's colleges and universities should be enhanced and expanded, particularly in those areas targeted by the state for economic development. Most states are enhancing their research base by direct funding, usually on a matching basis. The purpose of this part is to catalyze and enhance the growth of these technologies by encouraging interdisciplinary research activities in targeted areas. The Legislature recognizes that one source of funding is in matching state funds with federal funds and industrial support to provide the needed new technologies.

(2) The Legislature recommends that the governor consider the allocation of economic development funds for Centers of Excellence to be matched by industry and federal grants on at lease a two-for-one basis.

(3) The Legislature recommends that such funds be allocated on a competitive basis to the various colleges and universities in the state. The funds made available should be used to support interdisciplinary research in specialized Centers of Excellence in technologies that are considered to have potential for economic development in this state.

**History: C. 1953, 63-62-1, enacted by L. 1985, ch. 103, 1; 1986, ch. 109, 1; renumbered by L. 1992, ch. 241, 60.**

**Amendment Notes.** - The 1992 amendment, effective March 13, 1992, renumbered this section, which formerly appeared as 63-62-1, and substituted "part" for "chapter" in Subsection (1).

**9-2-602. Short title - Definitions.**

(1) This part is known as the Centers of Excellence Act."

(2) As used in this part, "Centers of Excellence" means university-based, industry-supported, cooperative research and development programs.

**History: C. 1953, 63-62-2, enacted by L. 1985, ch. 103, 2; 1986, ch. 109, 2; renumbered by L. 1992, ch. 241, 61.**

**Amendment Notes.** - The 1992 amendment, effective March 13, 1992, renumbered this section, which formerly appeared as 63-62-2, inserted the subsection designations; and substituted "part" for "chapter" in two places.